

**Board Report**

File #: 2018-0109, **File Type:** Contract**Agenda Number:** 27.

REVISED
SYSTEM SAFETY, SECURITY AND OPERATIONS COMMITTEE
APRIL 12, 2018

**SUBJECT: METRO RAIL CAPACITY STUDY
(MOTION 2017-0922 RESPONSE)****ACTION: RECEIVE AND FILE****RECOMMENDATION**

RECEIVE AND FILE report on Metro Rail capacity in response to Board Motion 2017-0922.

ISSUE

On January 25, 2018, the Board of Directors (Board) approved Motion #2017-0922 (Metro Rail Capacity Study) under Item 47, requesting staff to analyze current ridership as a percentage of maximum capacity for passengers at all existing rail stations during weekdays, weekends, peak, and off-peak hours. This report responds to the motion's request.

While there is generally capacity on the rail network during the non-peak periods, during the peak hours, trains on all rail lines meet and exceed the maximum capacity on a trip by trip basis as ridership demand pulses to the line from connecting bus and rails service, work shift start and end times, school bell times, etc.

DISCUSSION

Detailed rail ridership is collected continuously through a series of riding checks. The number of checks performed on a monthly basis is only large enough to permit estimation of ridership by line and day type. On an annual basis these checks can be aggregated to provide a more complete picture of ridership by station, direction, and time of day. The most recent annual ride check compilation spans FY2017.

Unlike the Metro bus system, rail cars are not all presently equipped with Automated Passenger Counters (APC's). APC's are provided as part of the current P3010 light rail vehicle (LRT) car order, however, staff is working to finalize the process and methodology for data capture and validation, which will include a one year FTA testing and approval process. Similarly, a retrofit of the P2000 LRV will incorporate APC's. However, delivery of the retrofitted P2000 LRVs will not begin until the start of 2020, with FTA testing and validation which requires an additional year. The planned procurement of

heavy rail vehicles (HRV) to replace the existing fleet and provide service for the extended Purple Line will provide APC's that are expected to be fully functional within five years from now.

As a result, the data used in this report was based on the full set of FY 2017 checks. Capacity is defined in the adopted Transit Service Policy, which states that maximum capacity (seated and standing) of a light rail line equals 175% of the seated capacity, or a load factor of 1.75. The maximum capacity of a heavy rail line equals 230% of the seated load, or 2.3 load factor. The load factor is higher for heavy rail as the seating configuration provides more space for standees. These capacity standards balance the goals of operating efficiency with customer comfort and the ability to periodically exceed the standard without passing up customers.

The analysis of ridership and capacity is presented in two attachments to this report. Attachment B shows ridership and capacity for each rail line and station, segmented by time period and day of week. The time periods shown are the highest passenger demand hours of each type of service (peak, off peak, Saturday and Sunday) for each direction of travel. Each chart shows the maximum capacity of all trains operated during that hour (solid line) and the number of total seats on those trains (dashed line). The hourly passenger load at each station is shown by a vertical bar with an extension of the bar showing higher loads experienced during the peak 20 minutes of demand.

Since Attachment B averages the passenger loads on board at each station during the time period, it masks the true variability in loads from trip to trip. For example, a train that carries 50% seated load may be followed by a train that carries 150% of seated load, which would result in an average of 100% seated load on each of the two trips. As a result, the variation in loads from train to train due to the pulsing of ridership arriving to each line based on connections from other bus and rail services, work and shift end times, school bell times, etc. are not represented. Therefore, Attachment C provides a detailed look at each trip's maximum ridership load factor (observed passengers per seats) for all weekday trips checked. A load factor of 1.00 represents the seated capacity of a train (shown with a dashed line), and a load factor of 1.75 (2.30 for the Red/Purple Line) represents the total maximum capacity of a train (shown with a solid line).

The charts indicate there is significant variation in demand from train to train within any specified hour due to the pulsing of ridership discussed above, with some observed trains exceeding the policy capacity. Table 1 summarizes the number of trips at each level of capacity from less than seated loads (load factor under 1.0) to over maximum capacity (load factor above 1.75 for LRT and 2.30 for HRT).

Table 1
Observed Number of Trips within Each Load Factor Range

	Peak	Direction	1.0 or Less	1.0 to 1.25	1.25 to 1.50	1.50 to 1.75	Over 1.75
Blue Line	AM	North	2	3	4	2	
	PM	South		4	2	2	2
Green Line	PM	East	3	4	5	4	
	AM	West	9	8			
Gold Line	PM	North				6	3
	AM	South		1	4	2	1
Expo Line	PM	East		1	3		7
	AM	West	2	3	2	2	1

	Peak	Direction	1.0 or Less	1.0 to 1.43	1.43 to 1.87	1.87 to 2.30	Over 2.30
Red/Purple Line	PM	East	1	1	7	2	1
	PM	West	1	4	1	6	

FINANCIAL IMPACT

Receive and File of this report would have no financial impact to the agency.

ATTACHMENTS

- Attachment A - Motion 2017-0922 Metro Rail Capacity Study
- Attachment B - Rail Ridership Data in Relation to Service Capacity
- Attachment C - Train By Train Loading in Relation to Train Capacity

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Phillip A. Washington
Chief Executive Officer



Board Report

File #:2017-0922, **File Type:**Motion / Motion Response

Agenda Number:47.

**REGULAR BOARD MEETING
JANUARY 25, 2018**

Motion by:

Fasana, Barger, Dupont-Walker, and Solis

Metro Rail Capacity Study

Ridership on Metro's lines continues to grow. Staff has continued to add capacity to Metro's lines by adding cars and increasing service frequency.

Passenger capacity varies considerably by line and by station. Metro needs to understand how much capacity is available on rail lines as development intensifies and demand for service increases.

**SUBJECT: MOTION BY FASANA, BARGER, DUPONT-WALKER
AND SOLIS**

Metro Rail Capacity Study

WE THEREFORE MOVE that Metro provide an analysis of current ridership as a percentage of maximum capacity for passengers at all existing rail stations during weekdays, weekends, on -peak, and off-peak hours and report the results to the Board at the April 2018 meetings.

Metro Rail Capacity Study

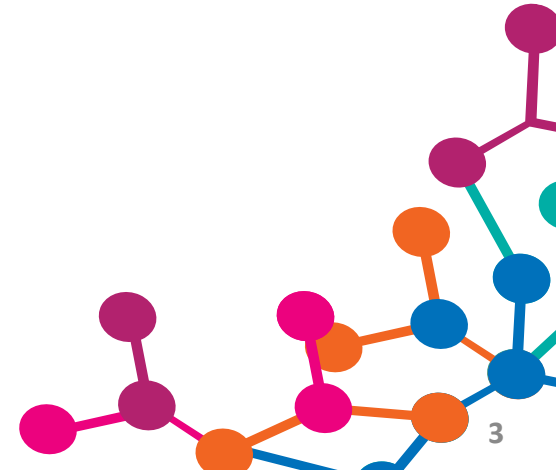
Overview

- Metro Rail Capacity Study Motion (January 2018)
- Analyze current ridership as a percentage of maximum capacity for passengers at all existing rail stations during:
 - Weekdays
 - Weekends
 - On-Peak Hours
 - Off-Peak Hours



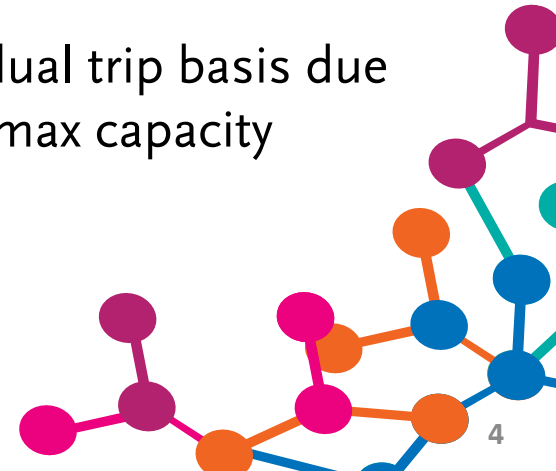
Data Collection

- Rail ridership data collected through manual counts and reported on a monthly basis at a line and day type level.
- Sampling methodology requires one year to collect enough data to generate station and time period level ridership. (FY17 most current)



Data Analysis

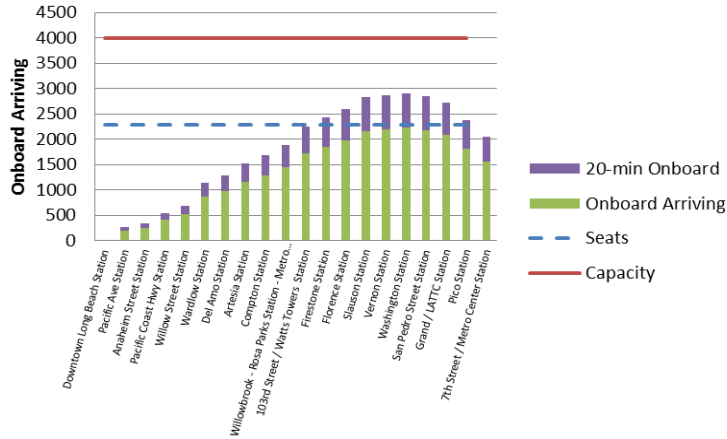
- Capacity (seated and standing) of a light rail line equals 175% of the seated capacity, or a load factor of 1.75. The maximum capacity of a heavy rail line equals 230% of the seated load, or 2.3 load factor.
- Capacity generally exists on the rail network during midday and weekends, with the exception of the Expo and Gold Lines when averaging all trips within a one hour and a 20 minute time slice.
- Standing capacity generally exists on all rail lines during peak periods in the peak direction when averaging trips.
- However, significant ridership variation on an individual trip basis due to “pulsing” of ridership, with many trips exceeding max capacity during the peak period.



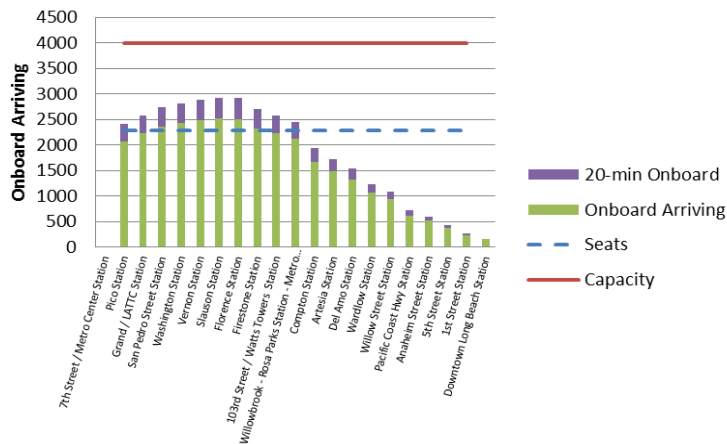
Findings – Weekday Peak Hours

Metro Blue Line

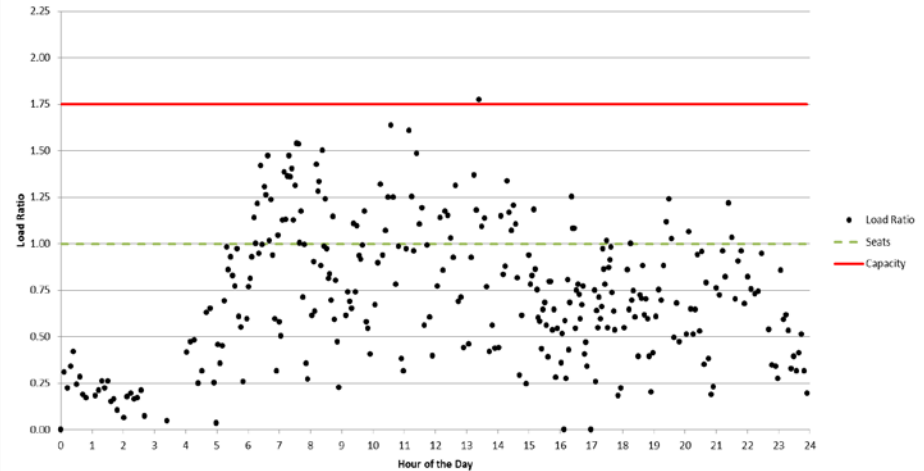
Metro Blue Line Weekday Northbound 7-8am



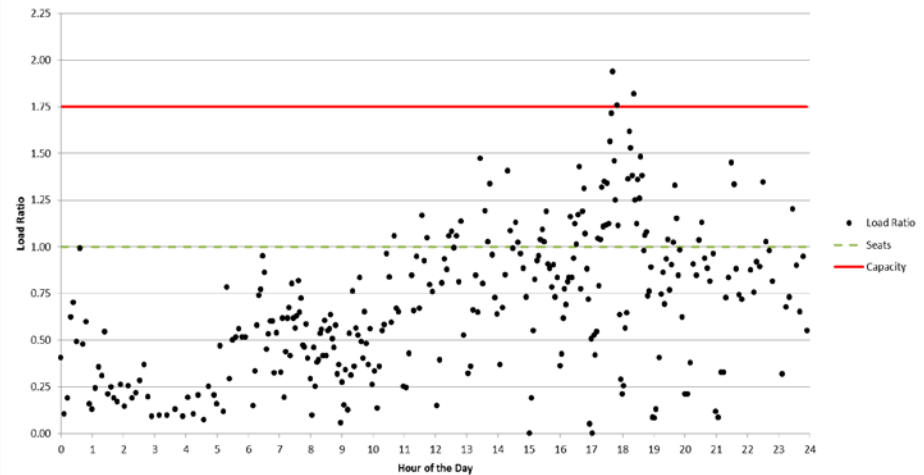
Metro Blue Line Weekday Southbound 5-6pm



Metro Blue Line Weekday Northbound Load Ratios

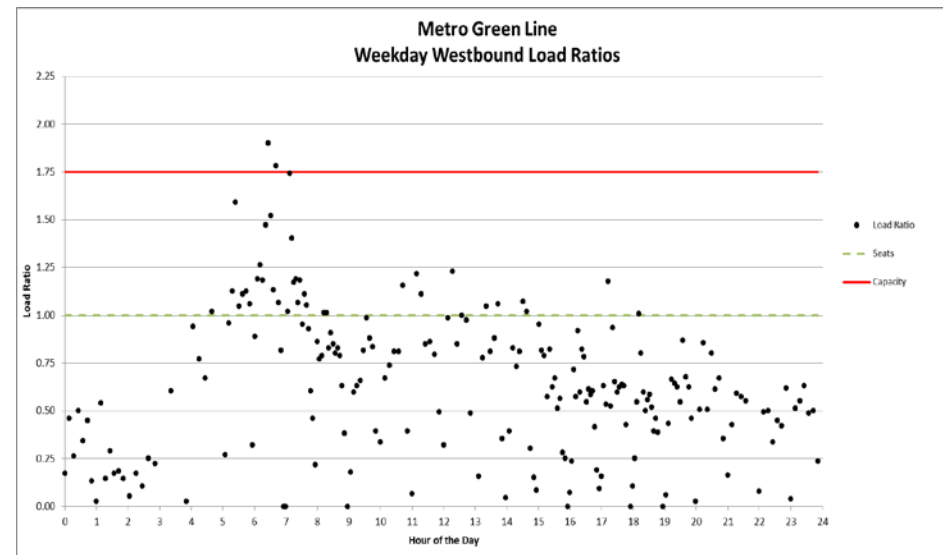
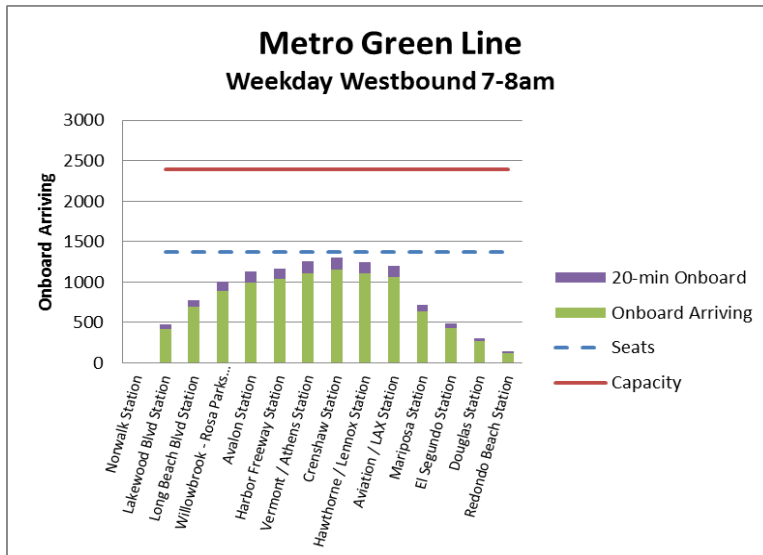
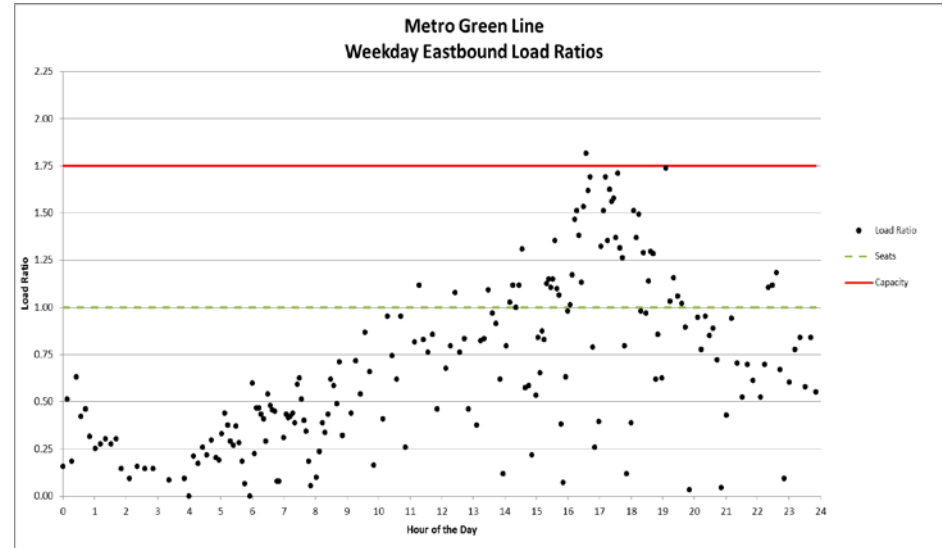
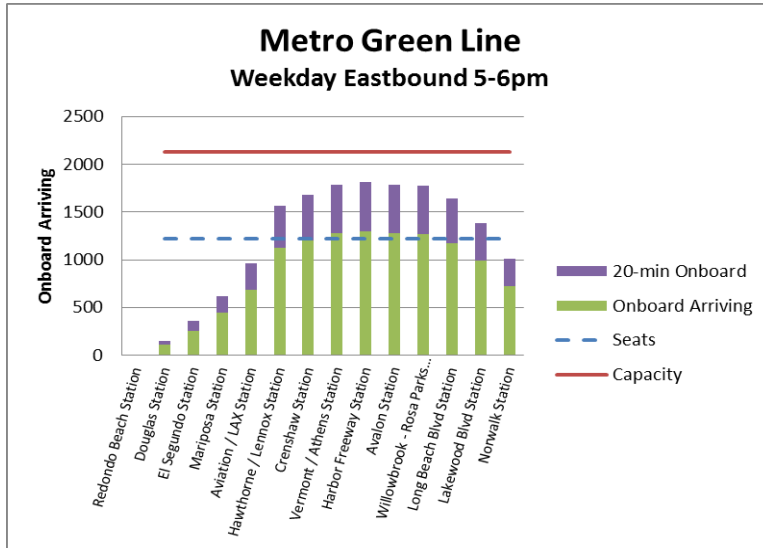


Metro Blue Line Weekday Southbound Load Ratios



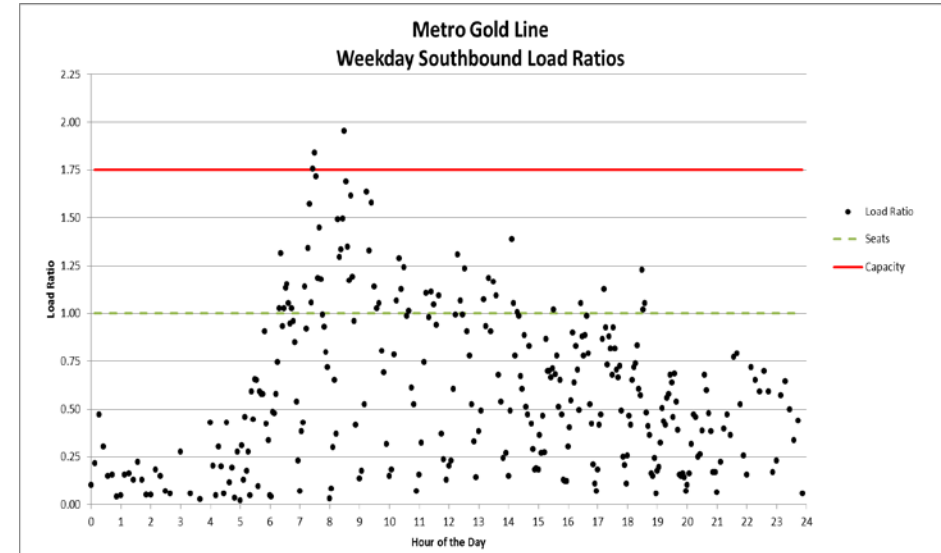
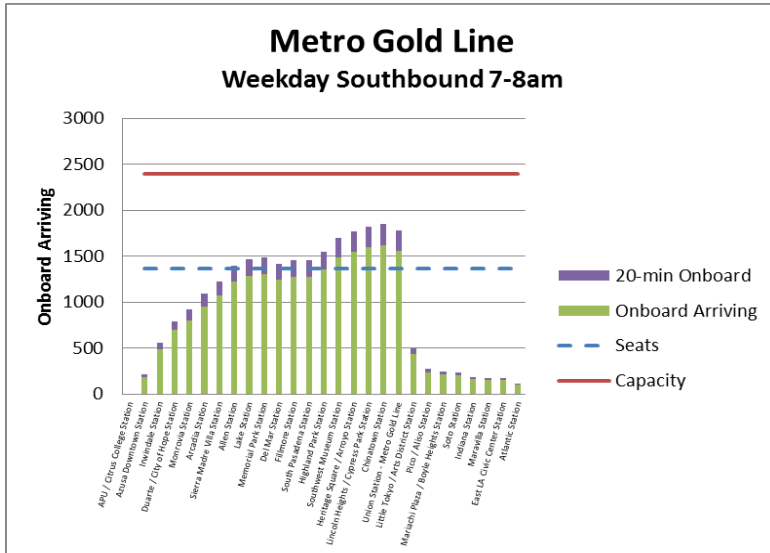
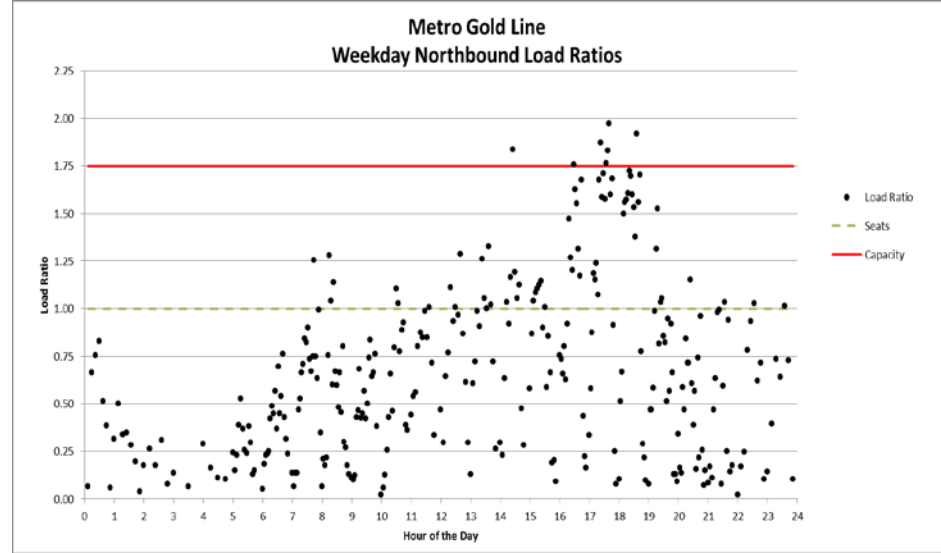
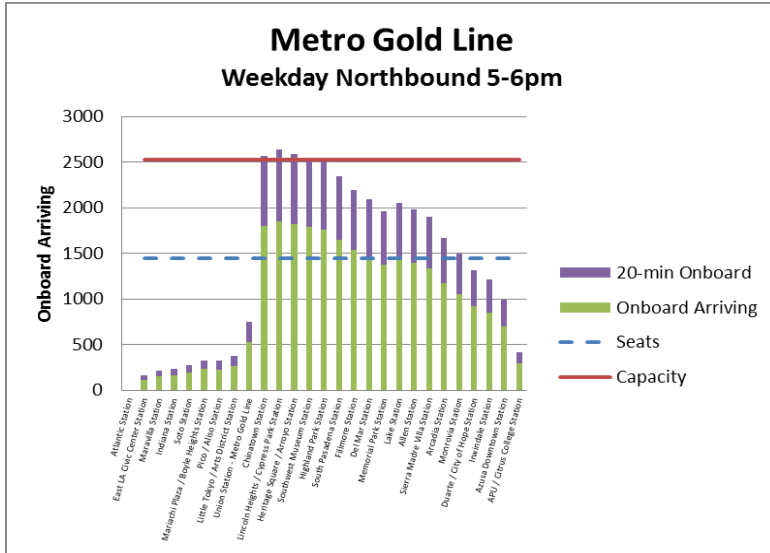
Findings – Weekday Peak Hours

Metro Green Line



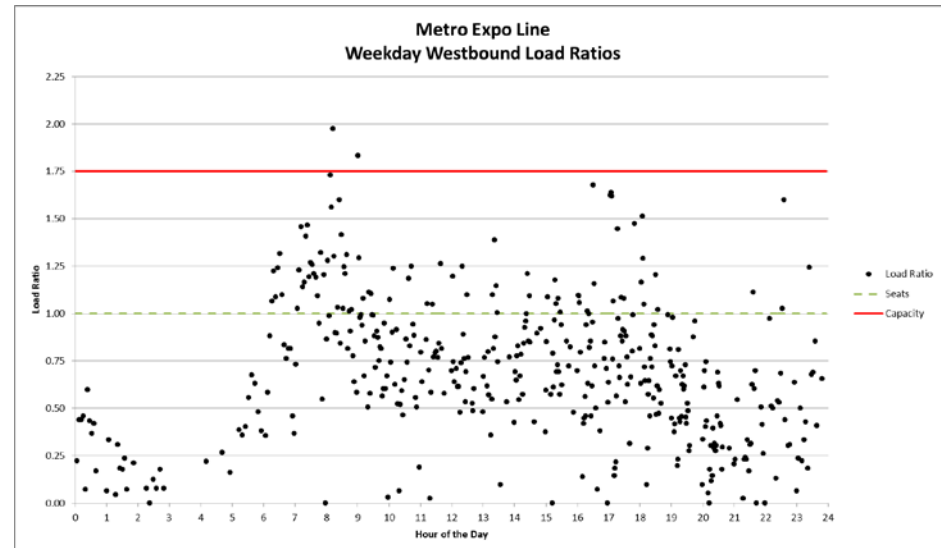
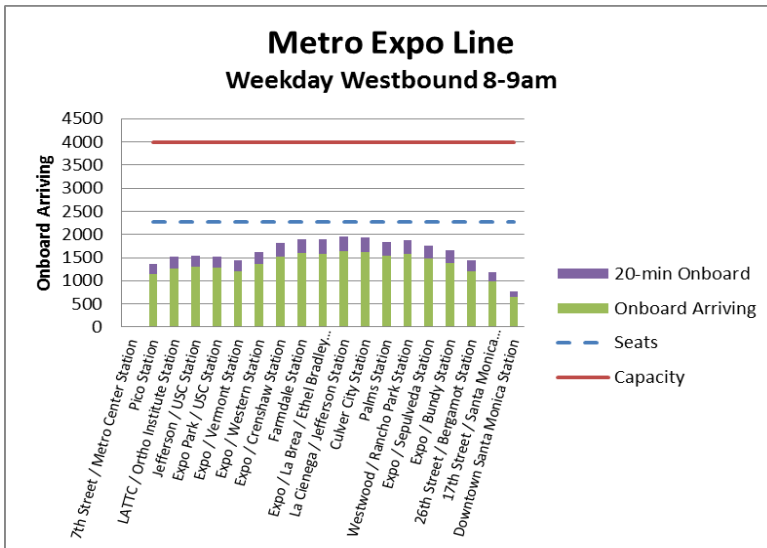
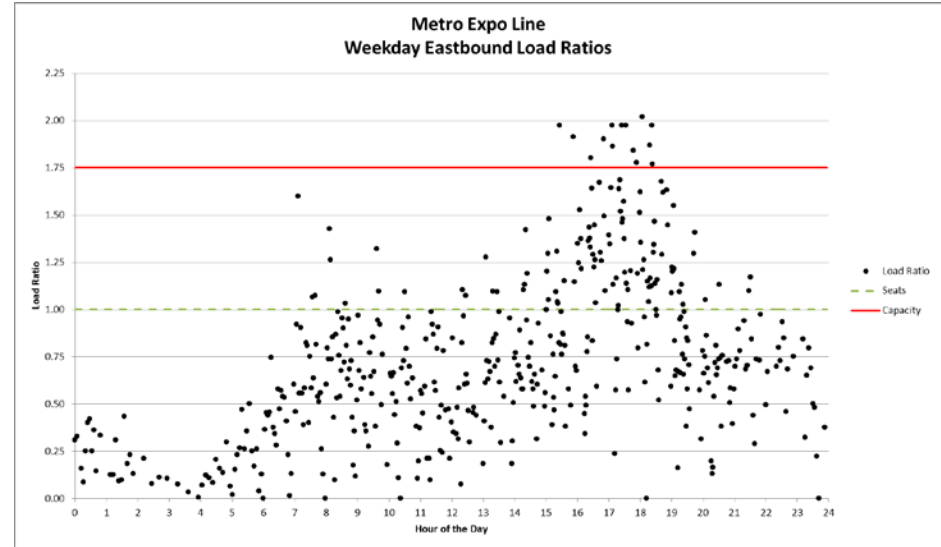
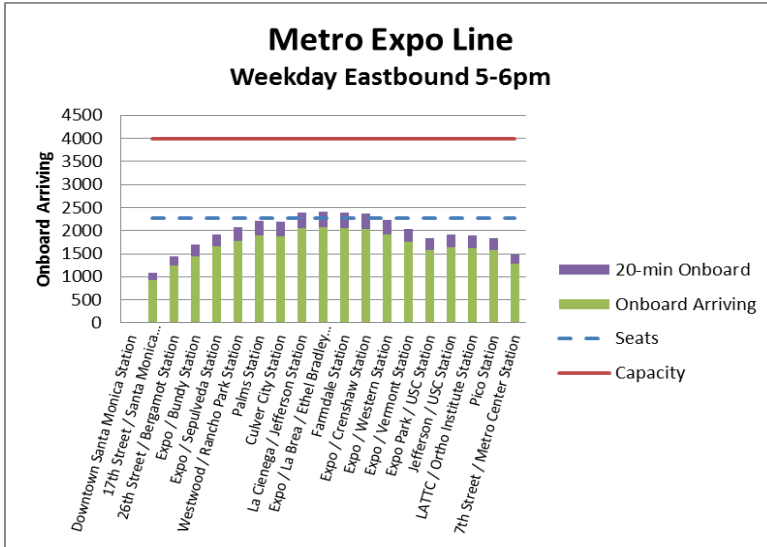
Findings – Weekday Peak Hours

Metro Gold Line



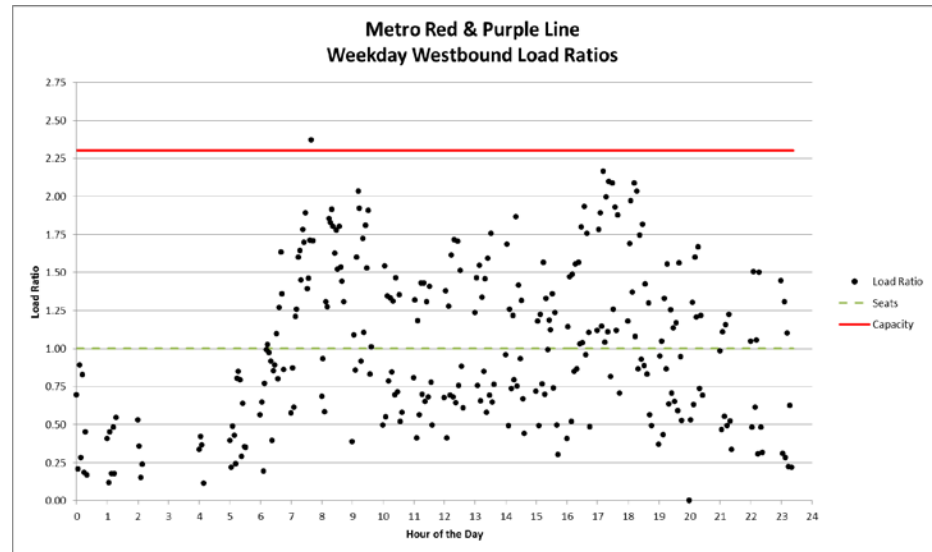
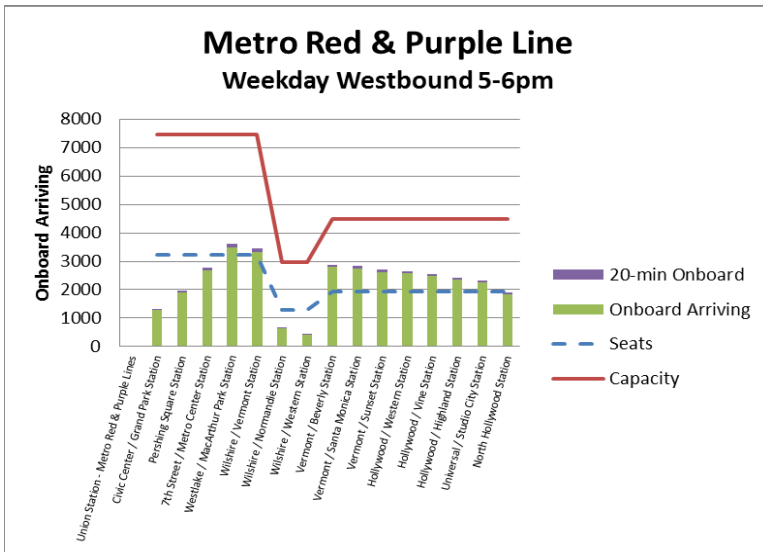
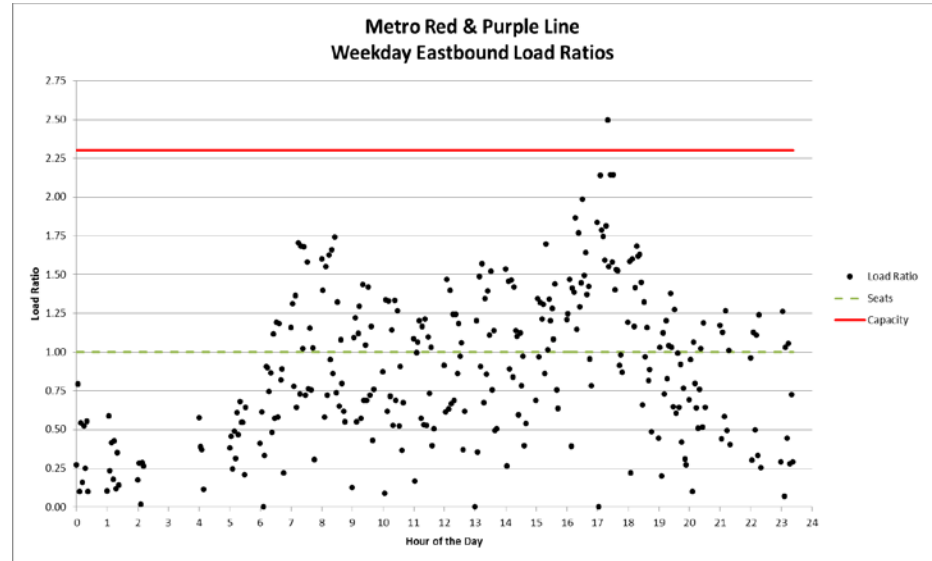
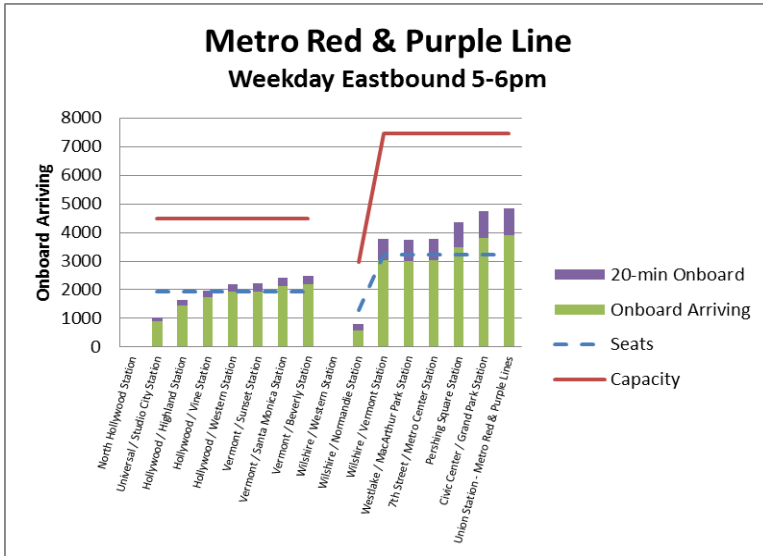
Findings – Weekday Peak Hours

Metro Expo Line



Findings – Weekday Peak Hours

Metro Red & Purple Line



Findings

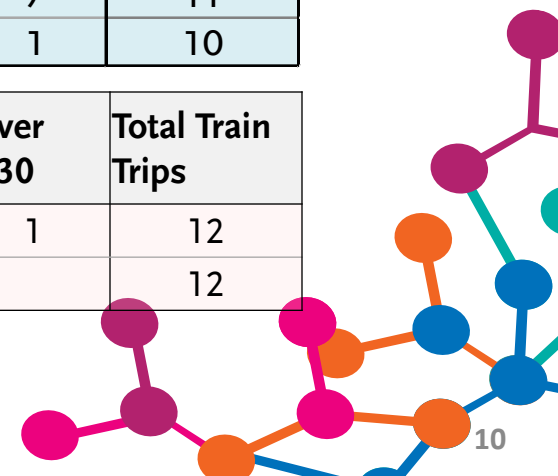
- The findings indicate there is significant variation in demand from train to train within any specified hour due to the pulsing of ridership, with some observed trains exceeding the policy capacity.
- The table summarizes the number of train trips observed at each level of capacity from less than seated loads (load factor under 1.0) to over maximum capacity (load factor above 1.75 for LRT and 2.30 for HRT).

Line	Direction	Peak Hour	1.0 or Less	1.0 to 1.25	1.25 to 1.50	1.50 to 1.75	Over 1.75	Total TrainTrips
Blue Line	North	AM	2	3	4	2		11
	South	PM		4	2	2	2	10
Green Line	East	PM	3	4	5	4		16
	West	AM	9	8				17
Gold Line	North	PM				6	3	9
	South	AM		1	4	2	1	8
Expo Line	East	PM		1	3		7	11
	West	AM	2	3	2	2	1	10

Line	Direction	Peak Hour	1.0 or Less	1.0 to 1.43	1.43 to 1.87	1.87 to 2.30	Over 2.30	Total Train Trips
Red/Purple Line	East	PM	1	1	7	2	1	12
	West	PM	1	4	1	6		12



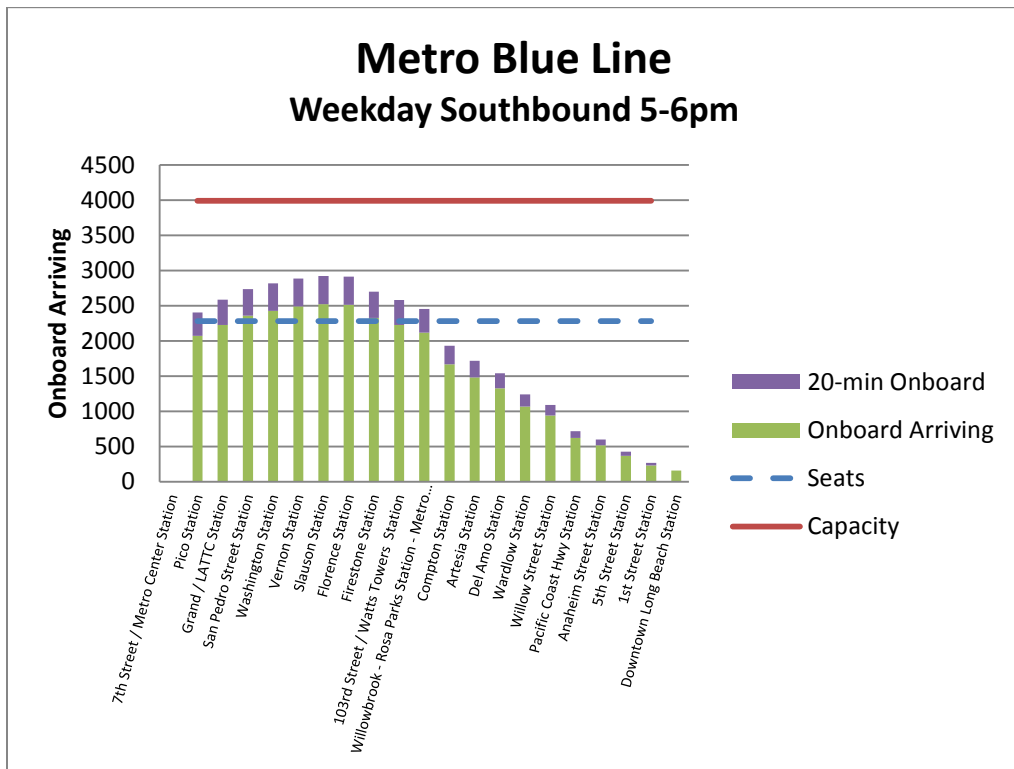
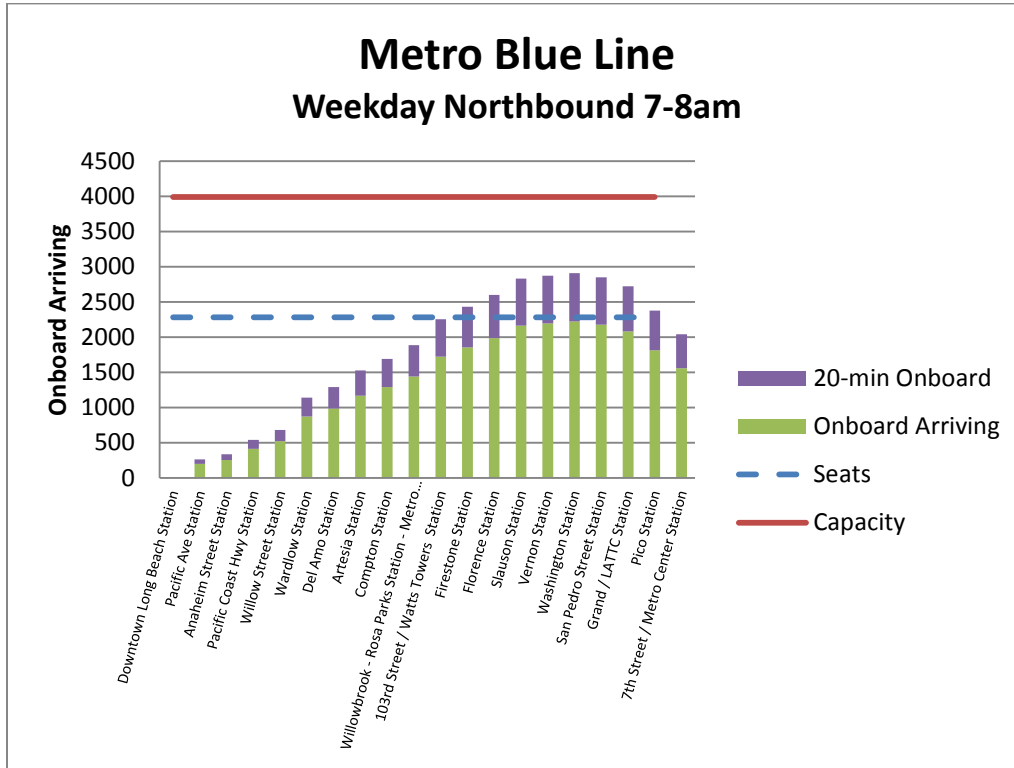
Metro



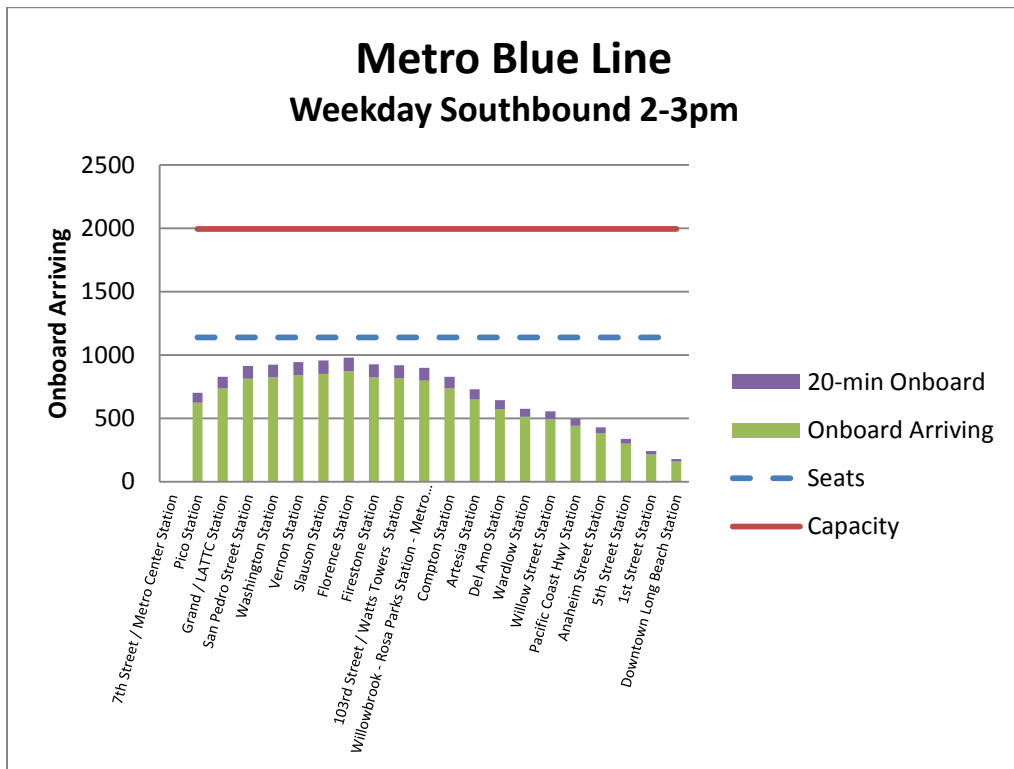
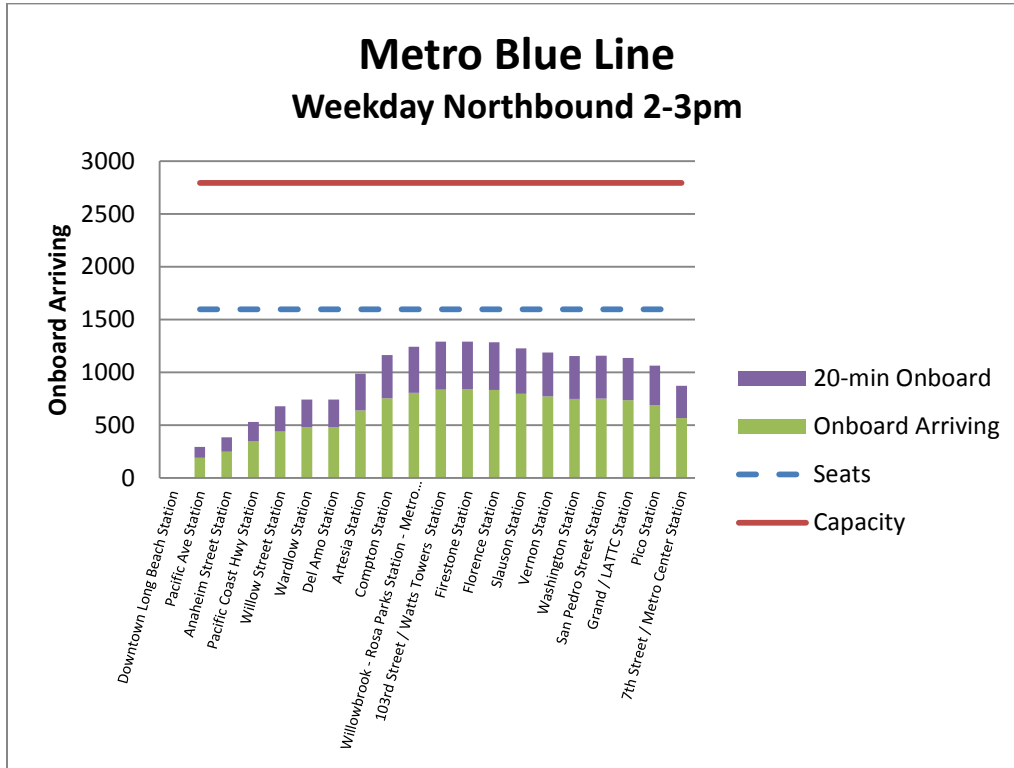
REVISED - ATTACHMENT B

Rail Ridership Data in Relation to Service Capacity

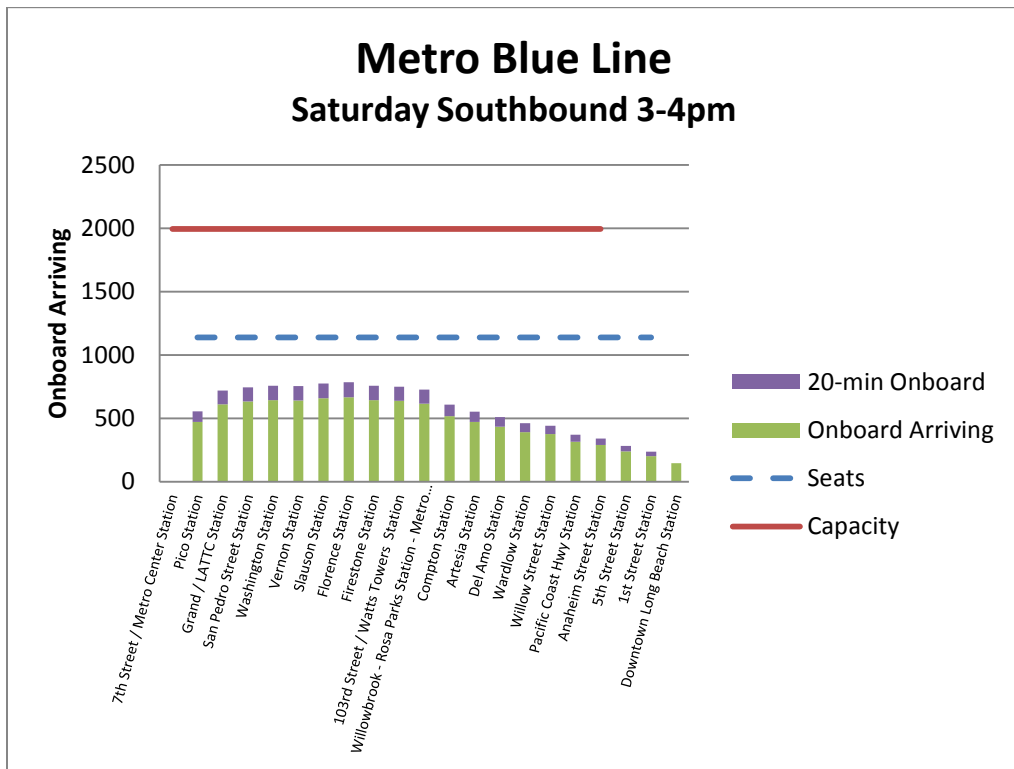
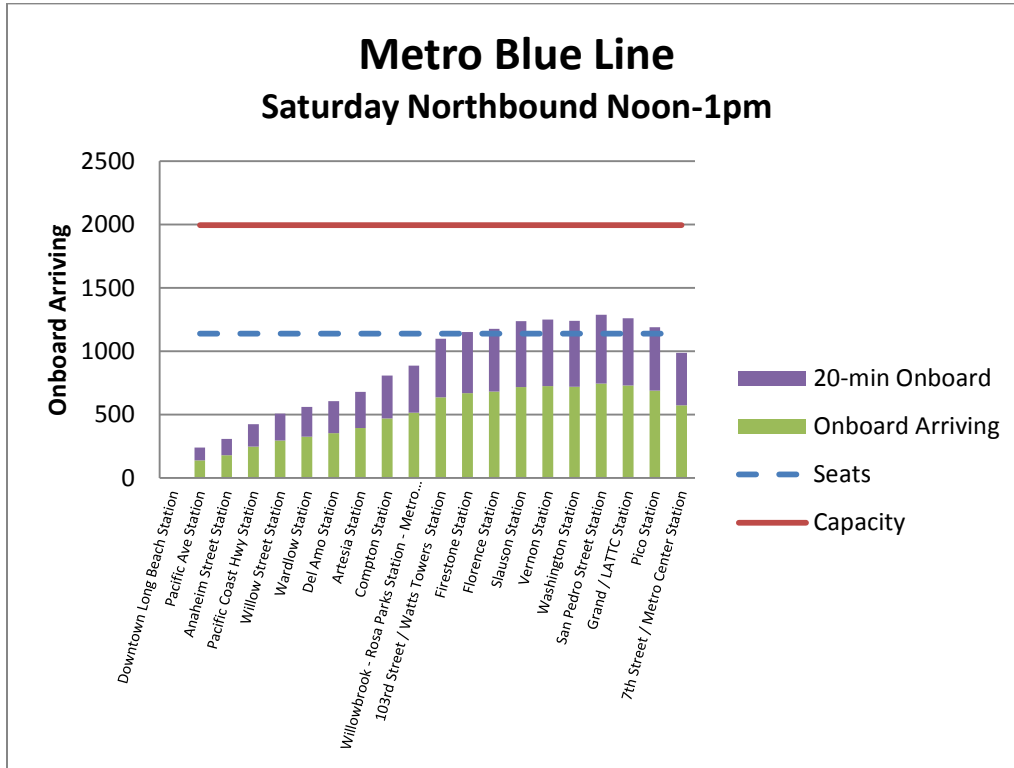
METRO BLUE LINE
Weekday Peak Hours



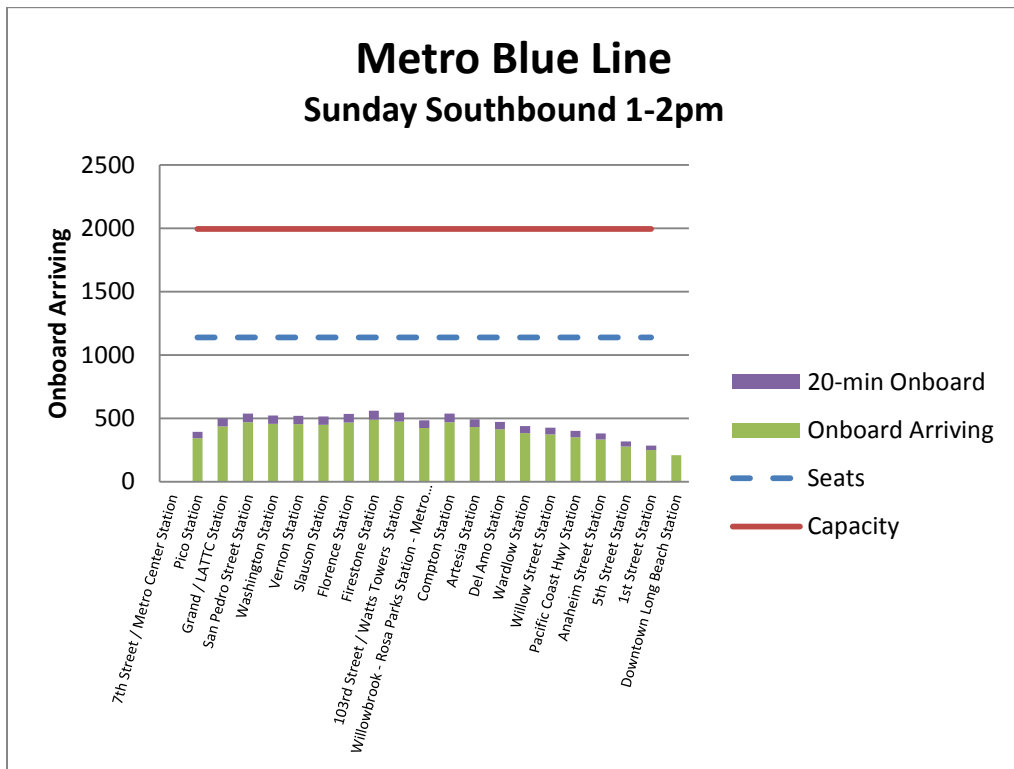
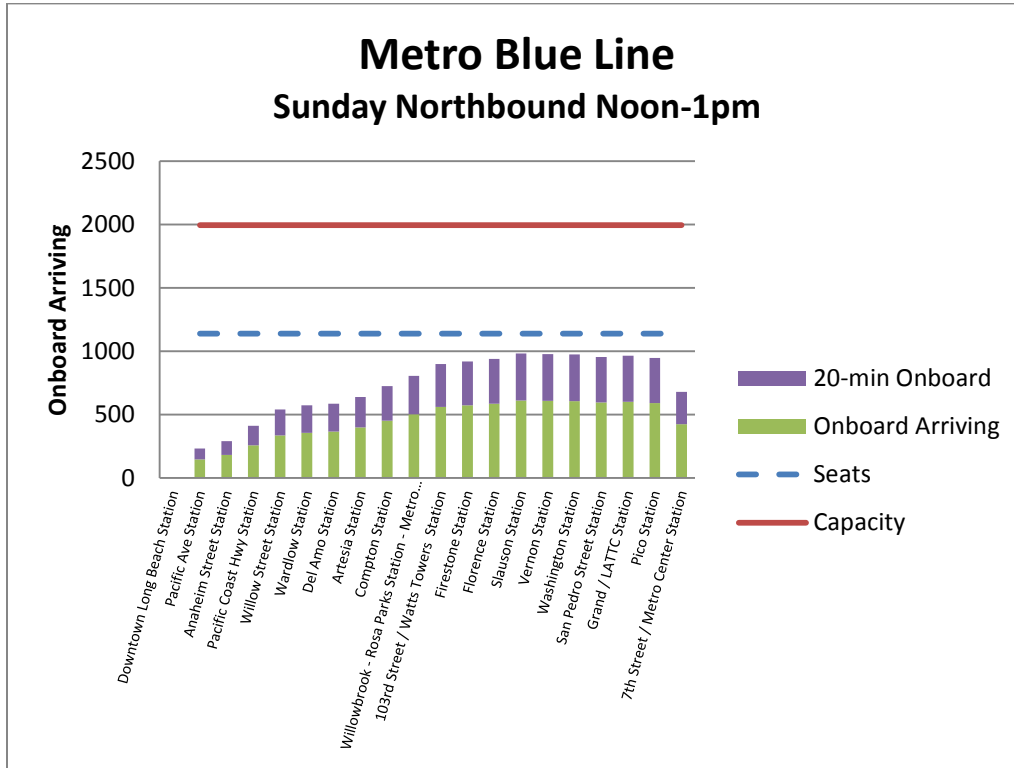
METRO BLUE LINE
Weekday Off Peak Hours



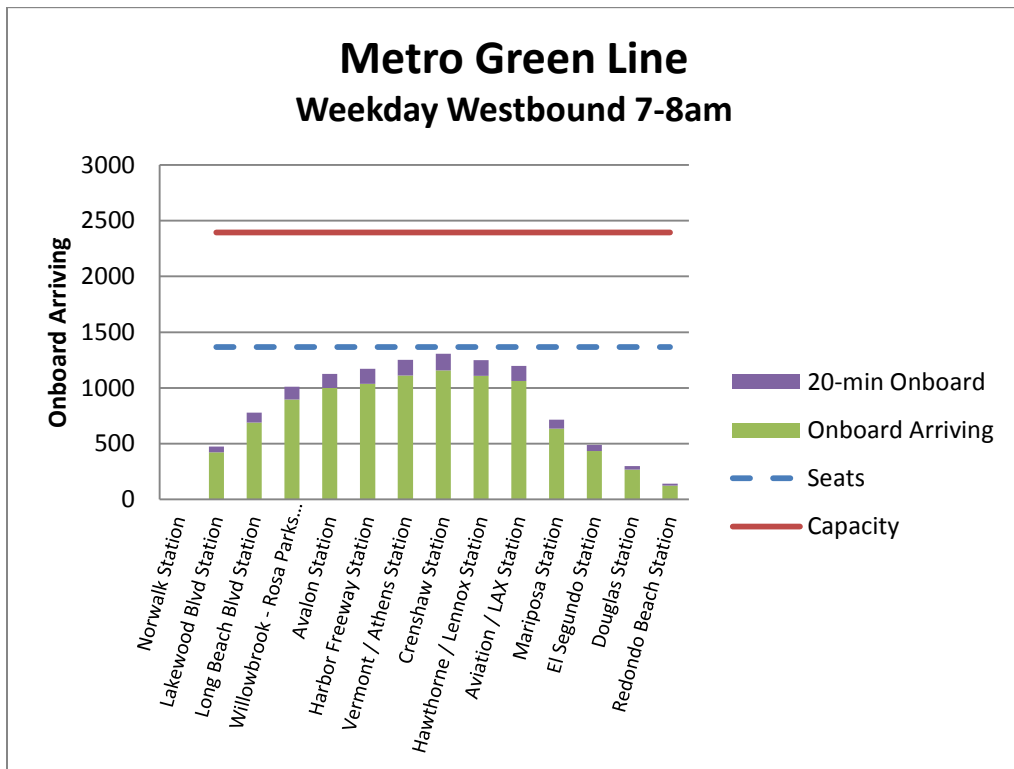
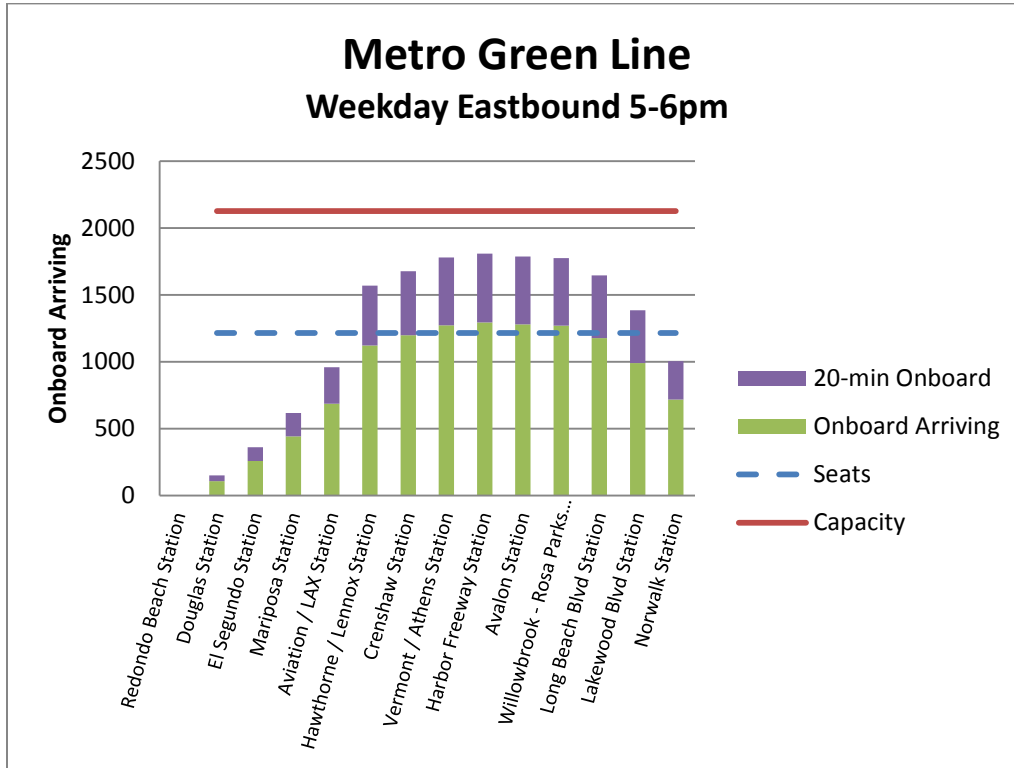
METRO BLUE LINE
Saturdays



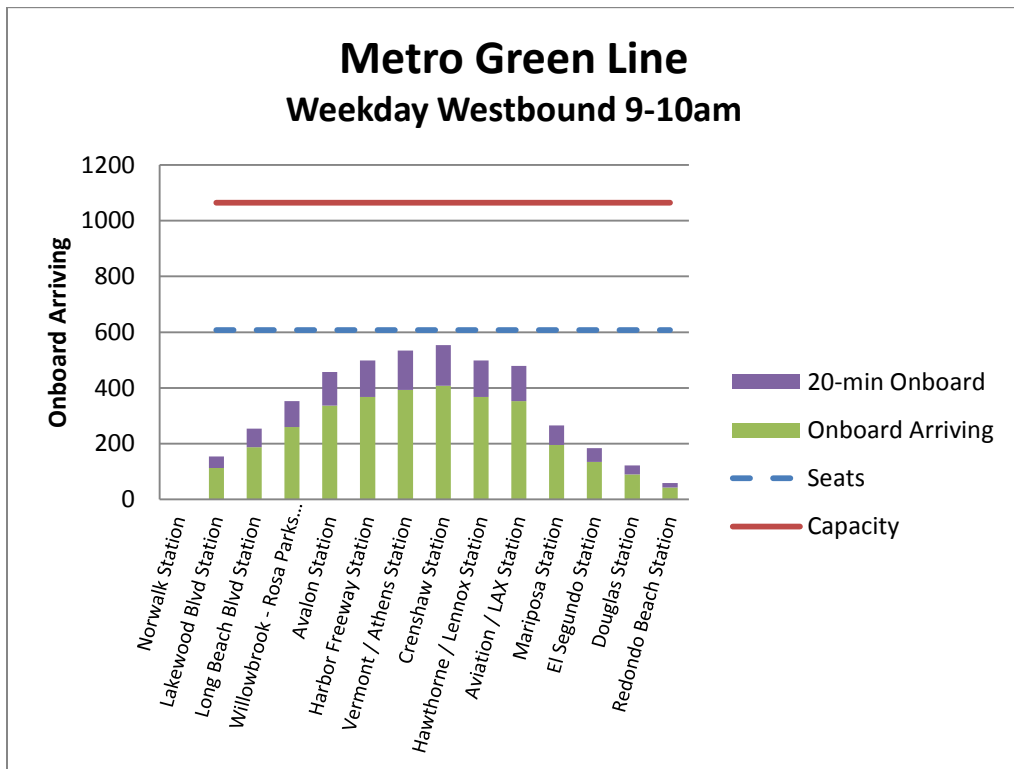
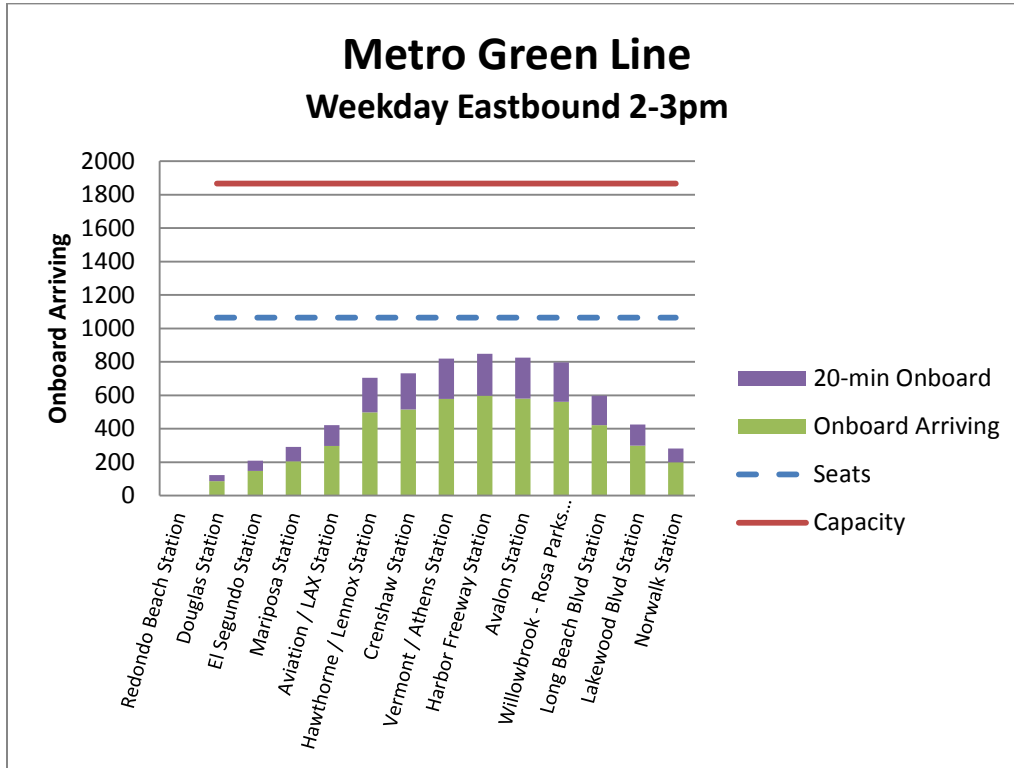
METRO BLUE LINE
Sundays



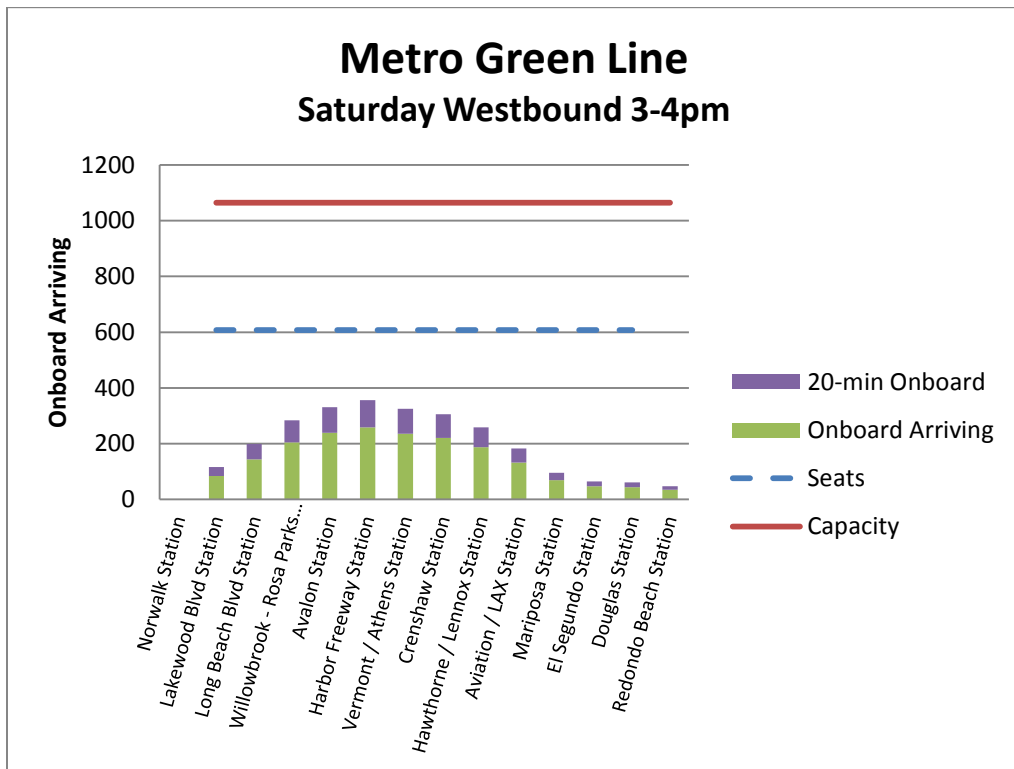
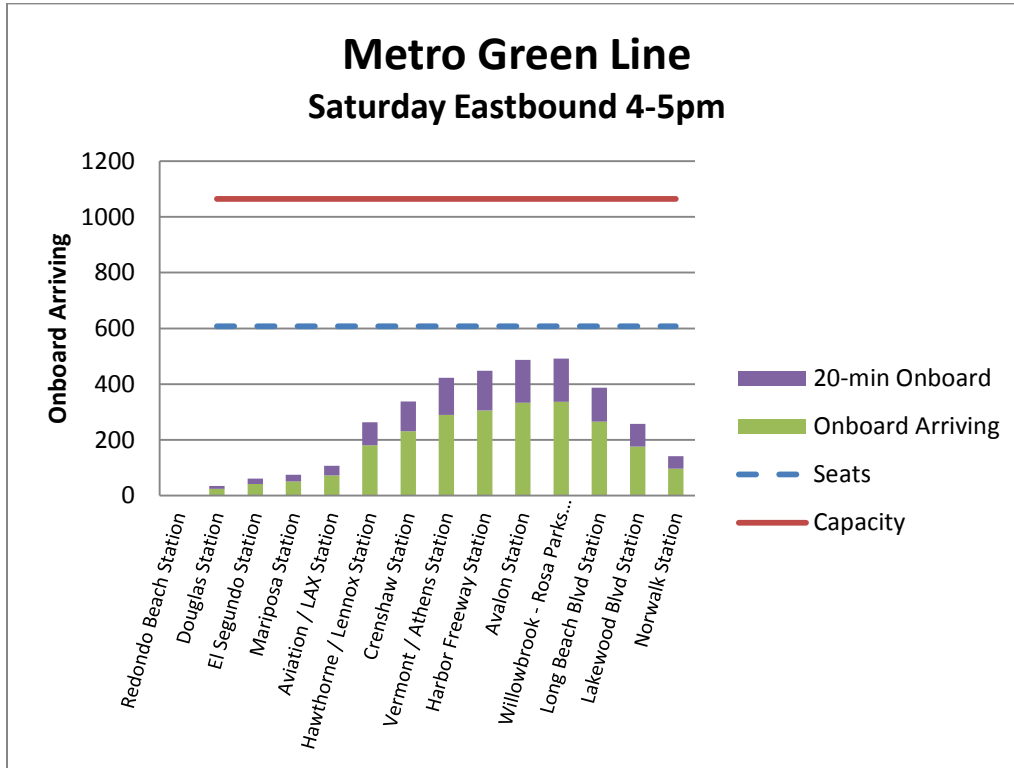
METRO GREEN LINE
Weekday Peak Hours



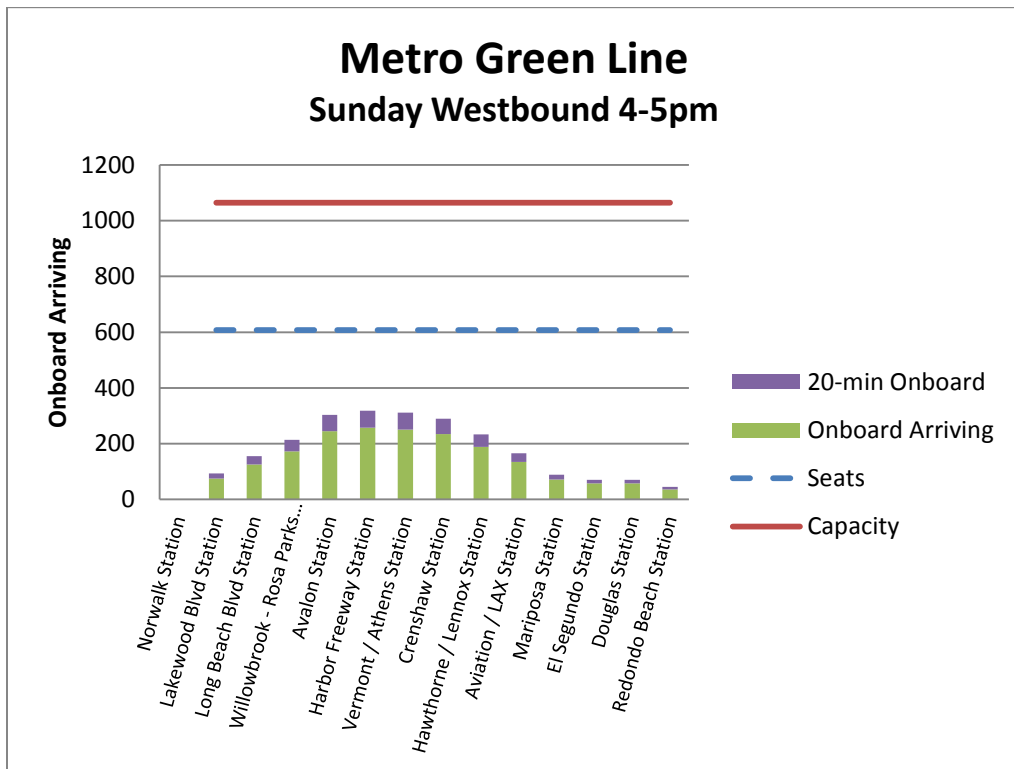
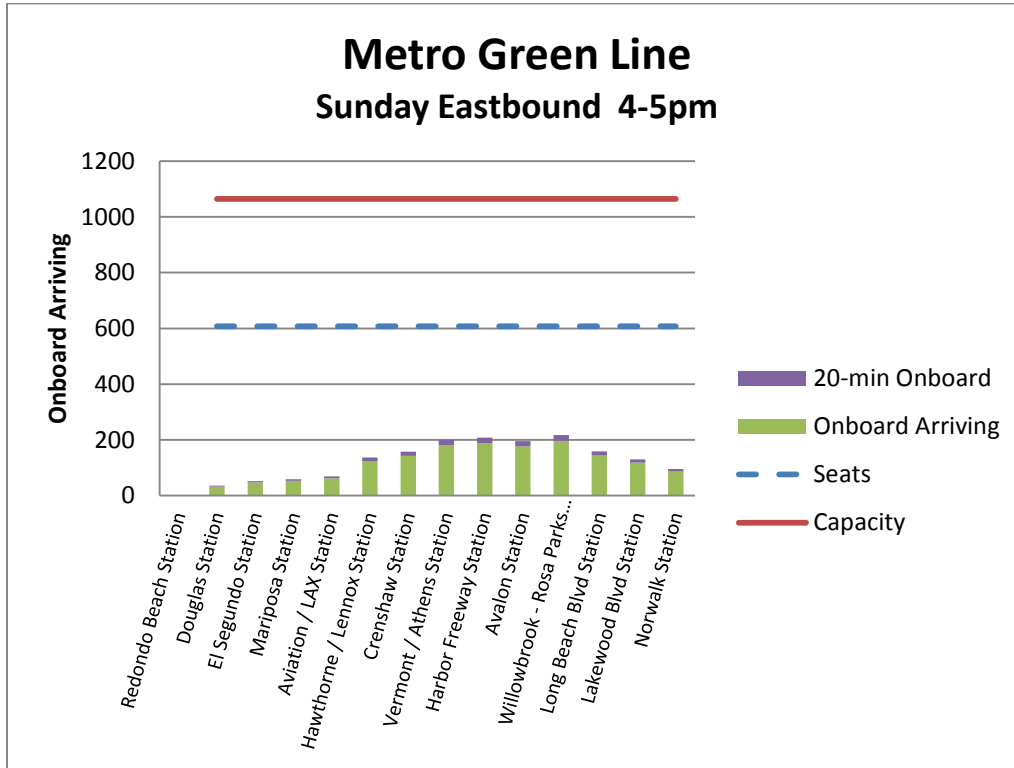
METRO GREEN LINE
Weekday Off Peak Hours



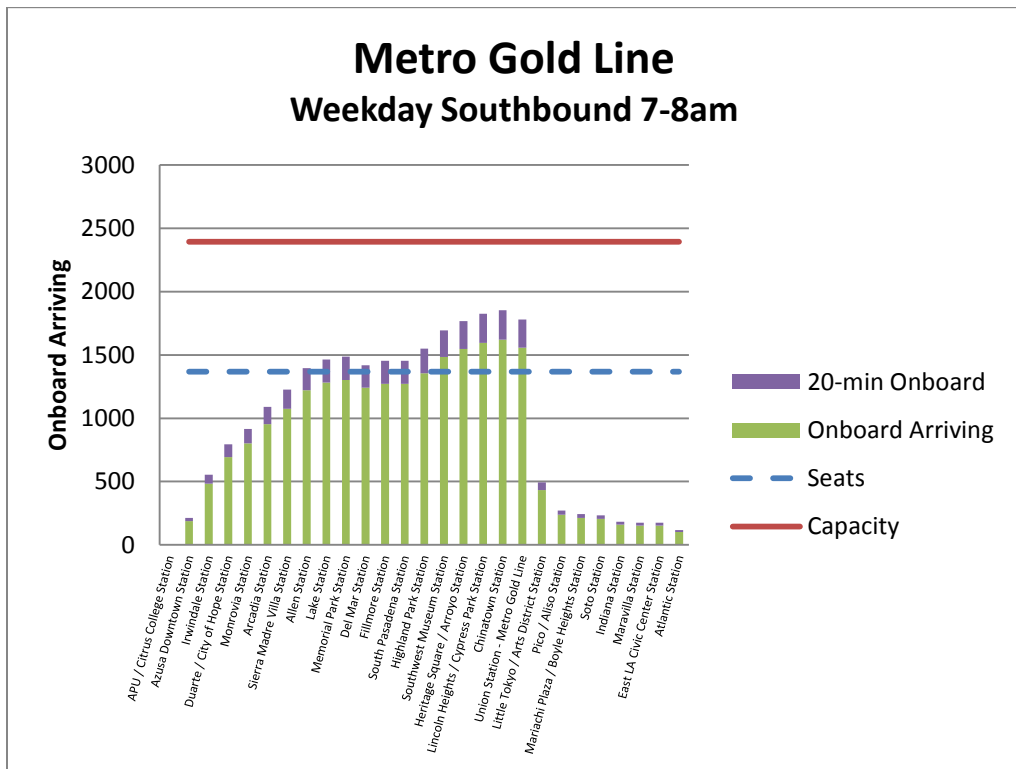
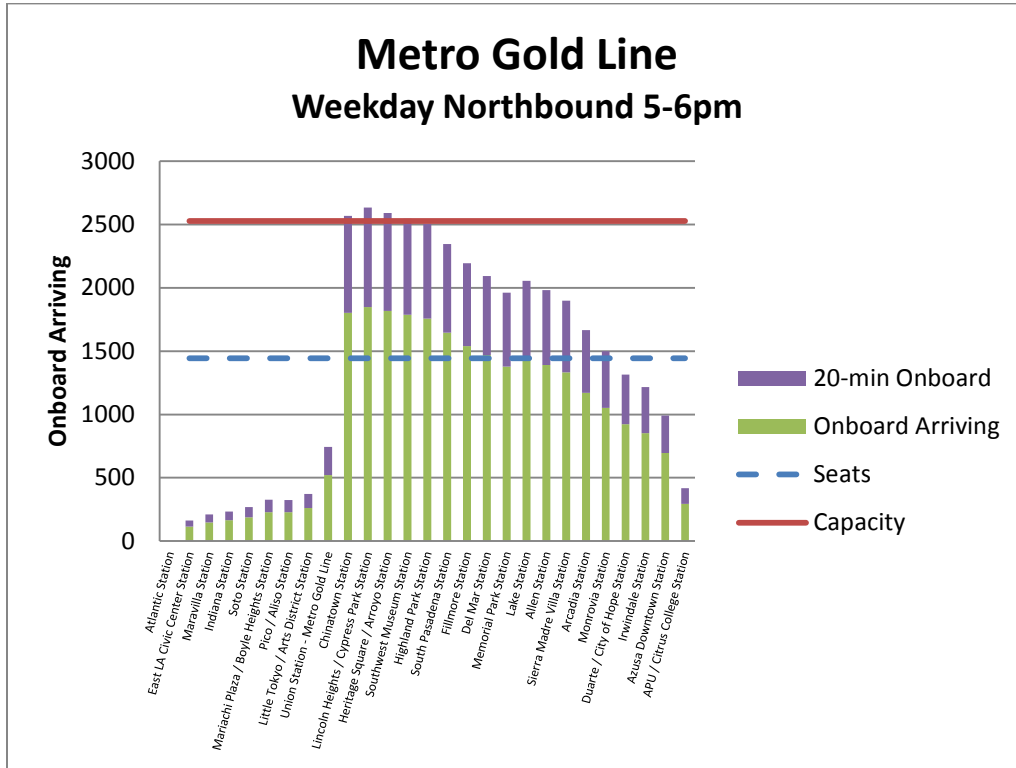
METRO GREEN LINE
Saturdays



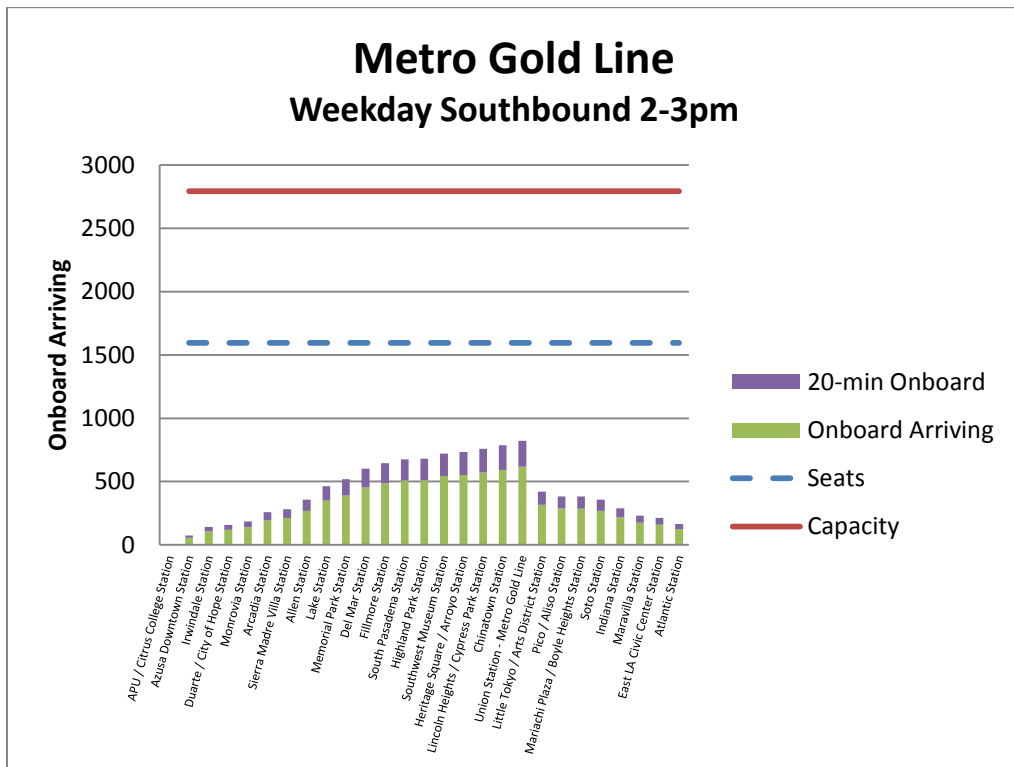
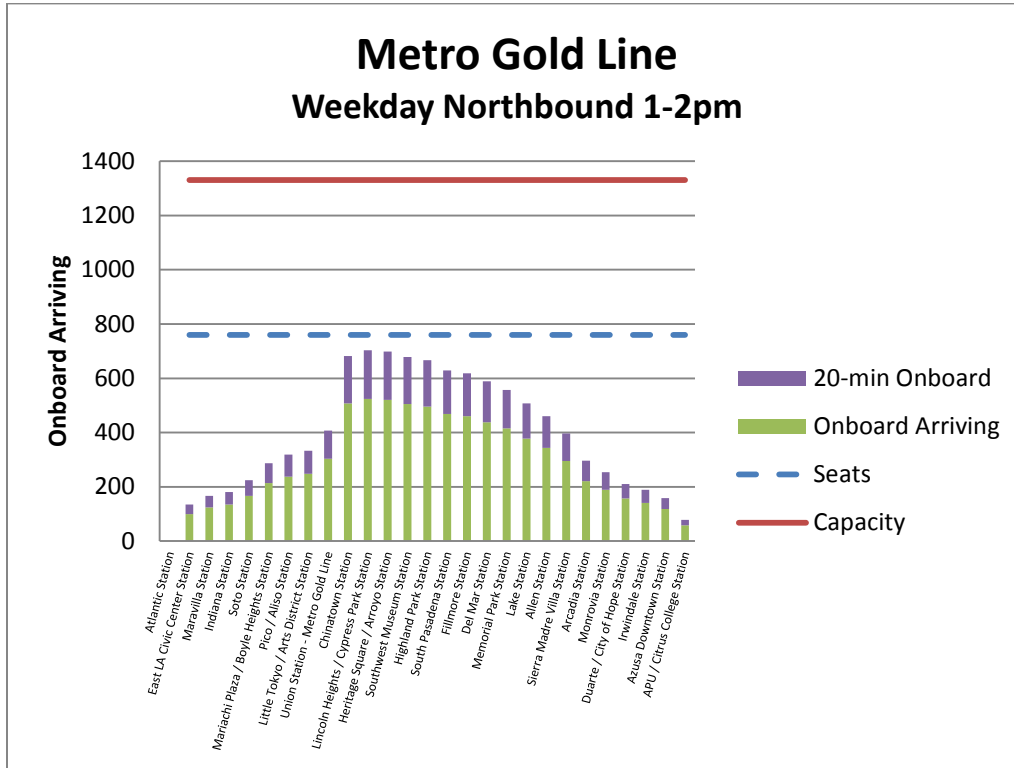
METRO GREEN LINE
Sundays



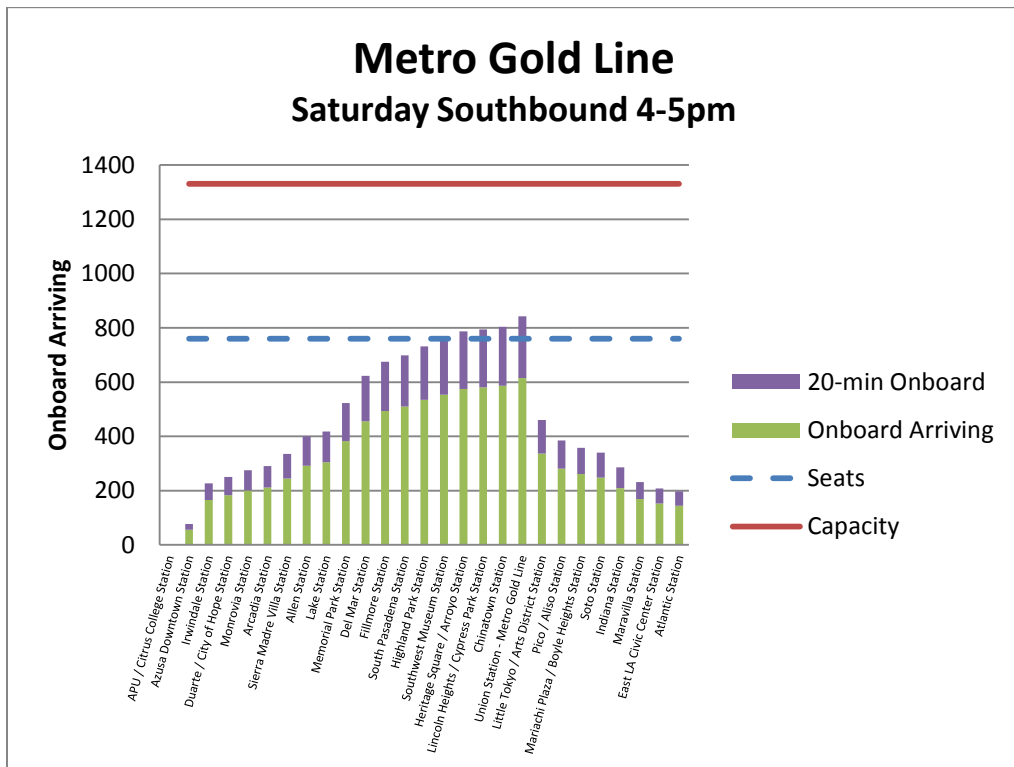
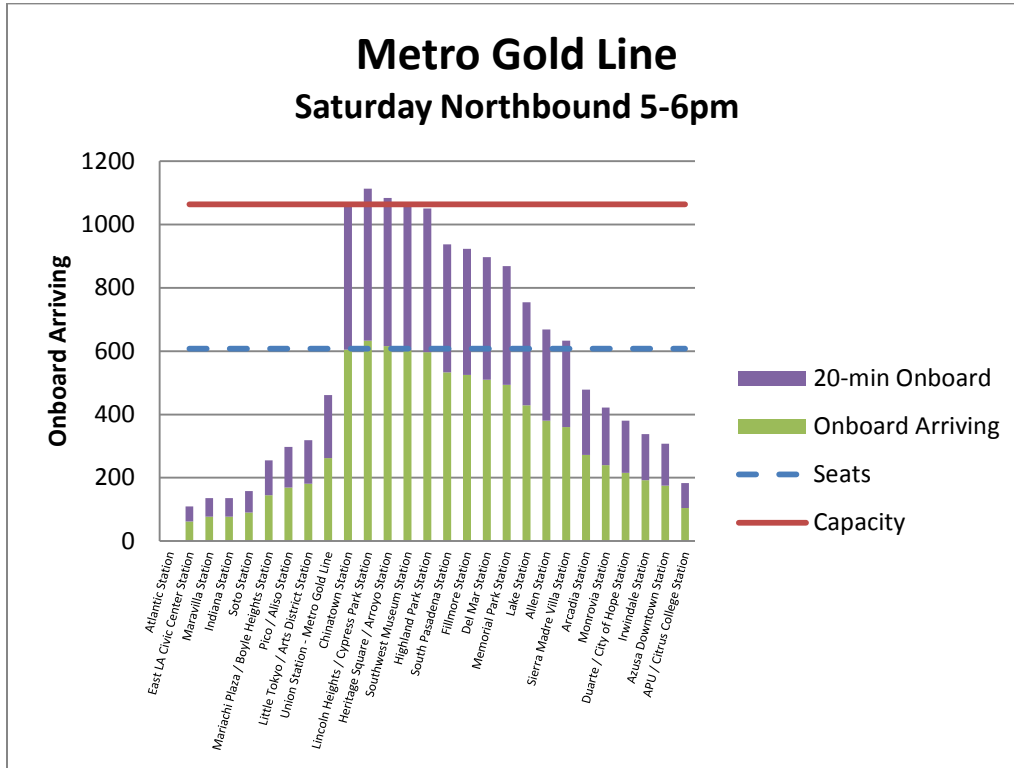
METRO GOLD LINE
Weekday Peak Hours



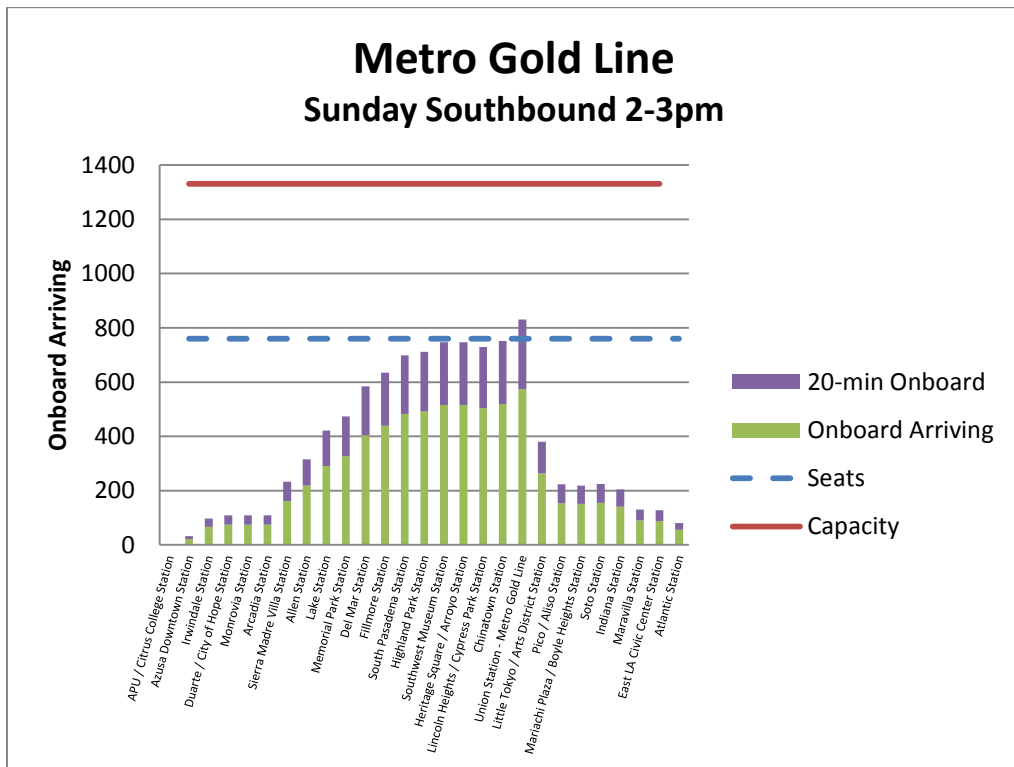
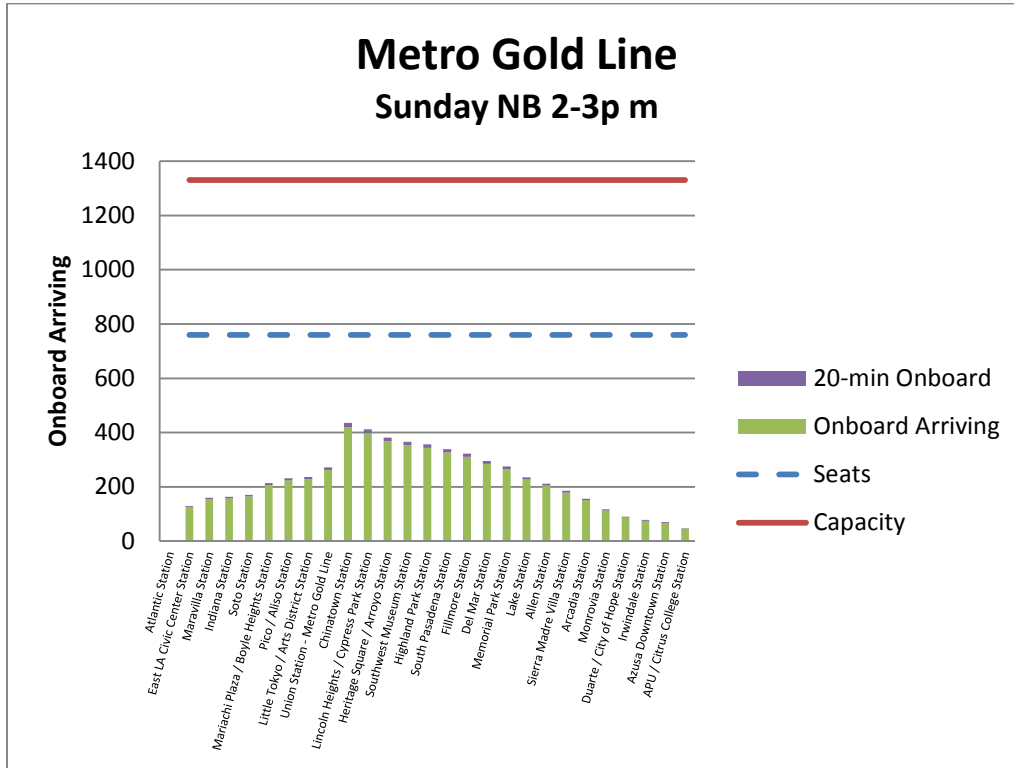
METRO GOLD LINE
Weekday Off Peak Hours



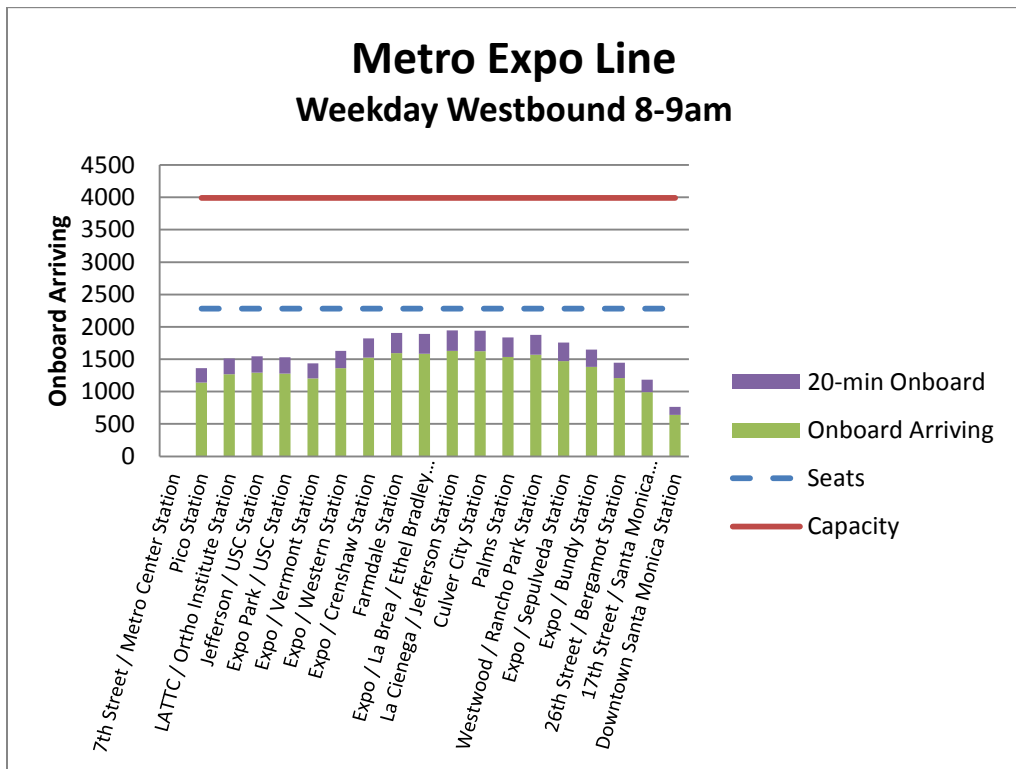
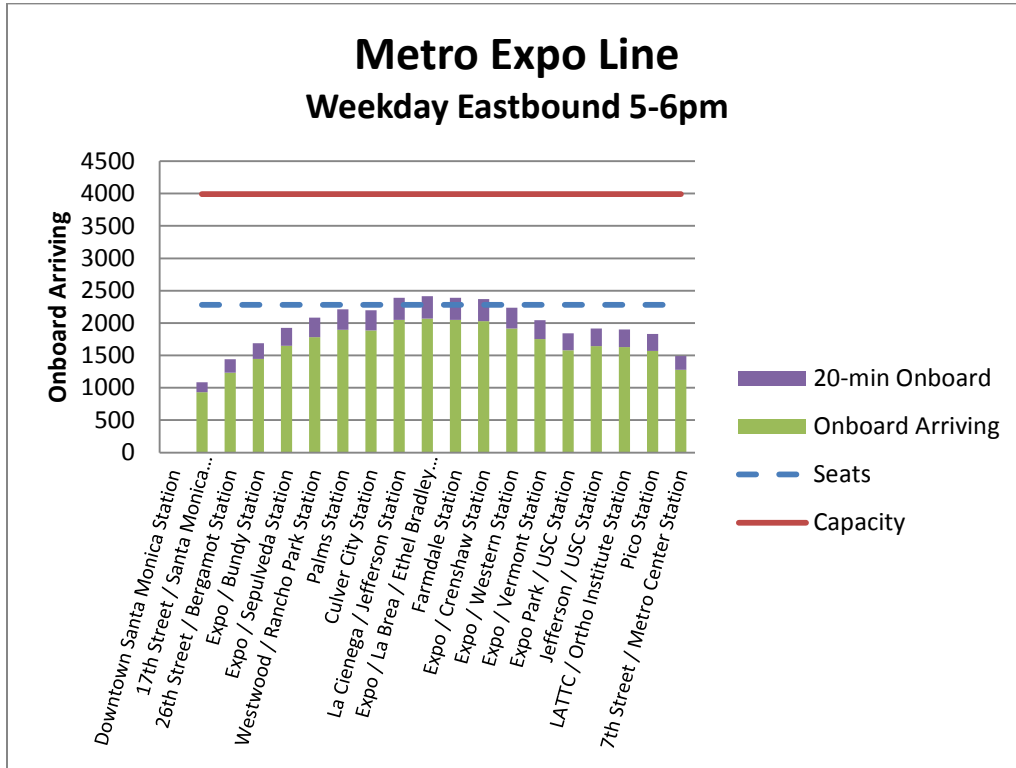
METRO GOLD LINE
Saturdays



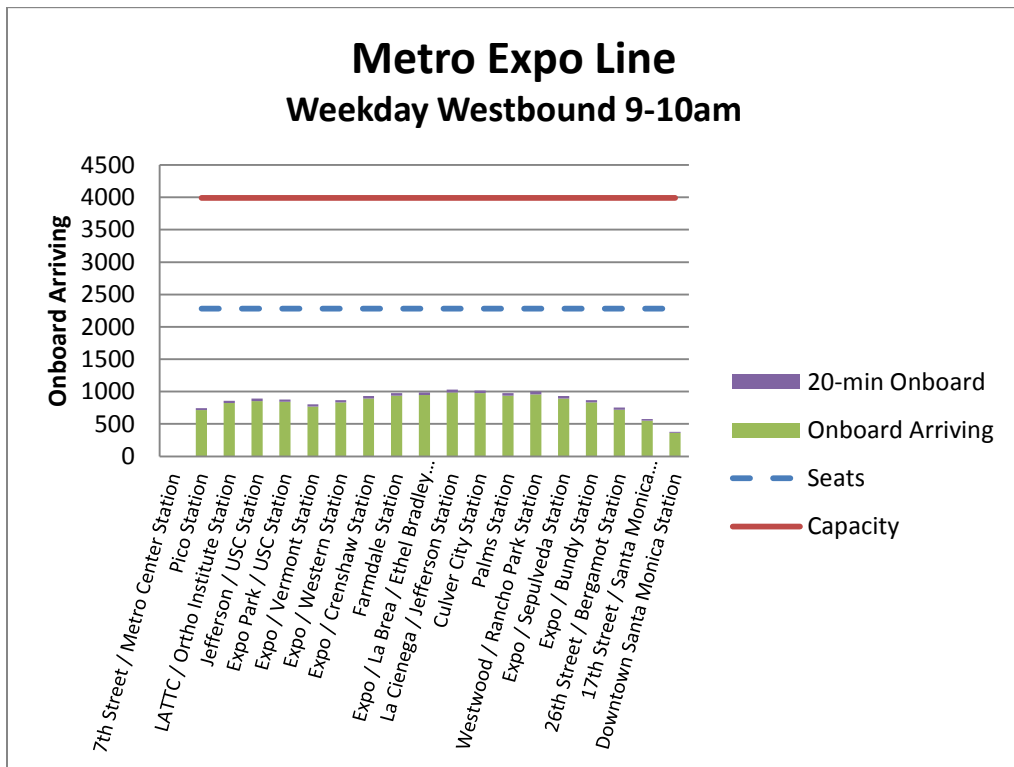
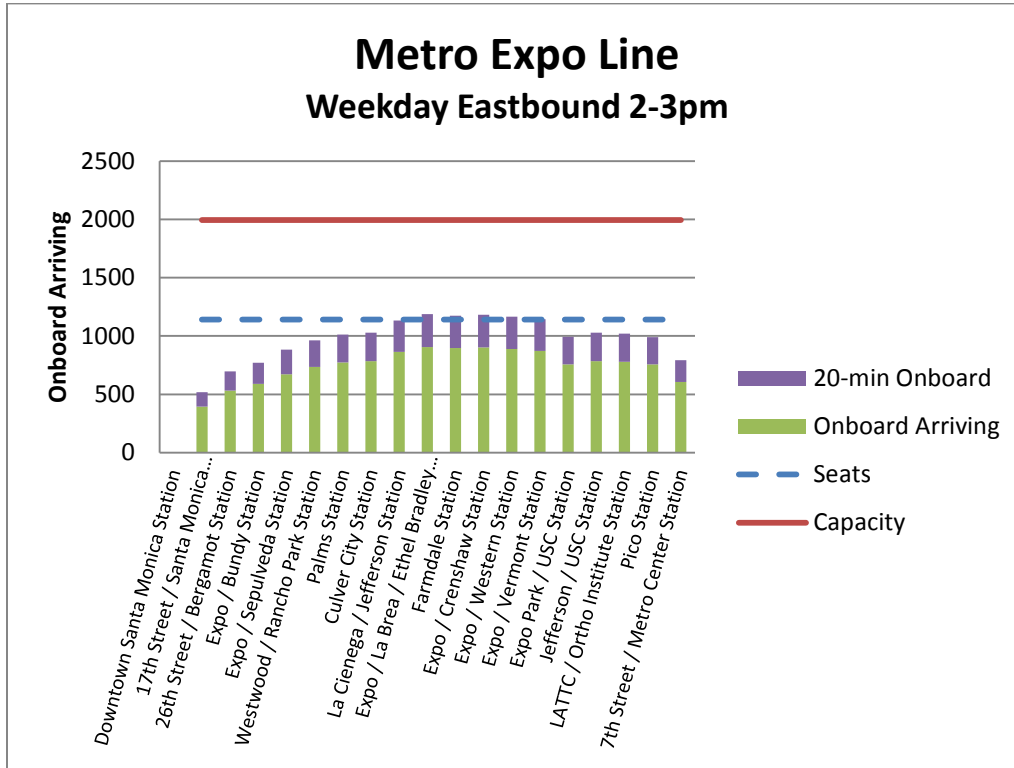
METRO GOLD LINE
Sundays



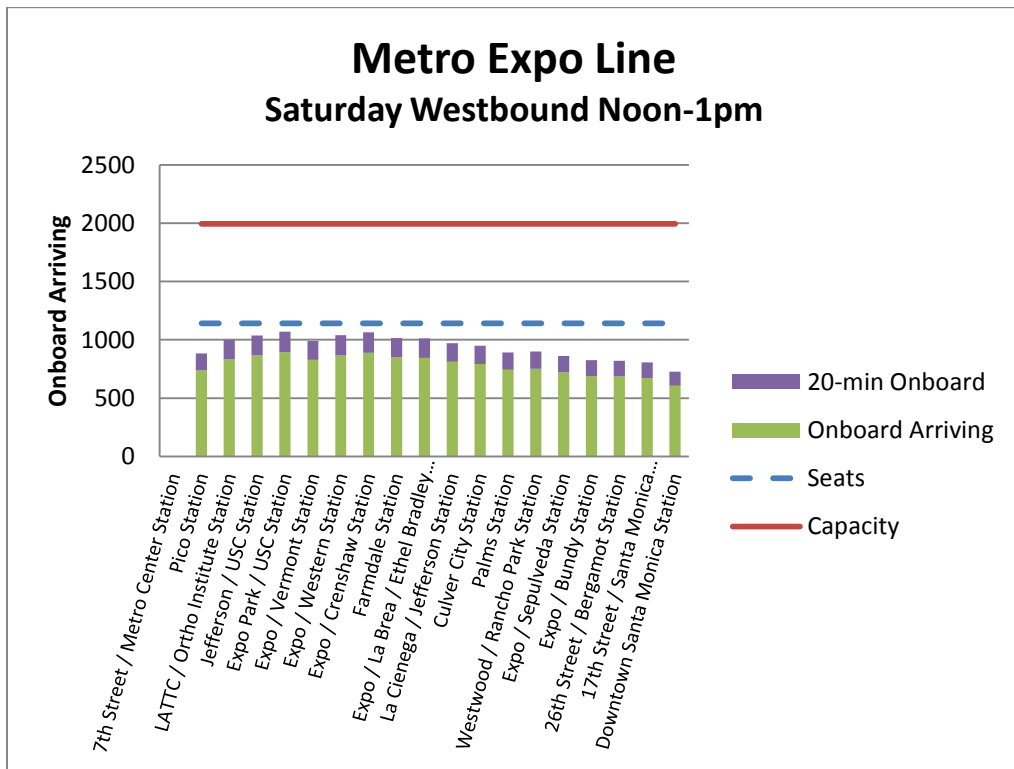
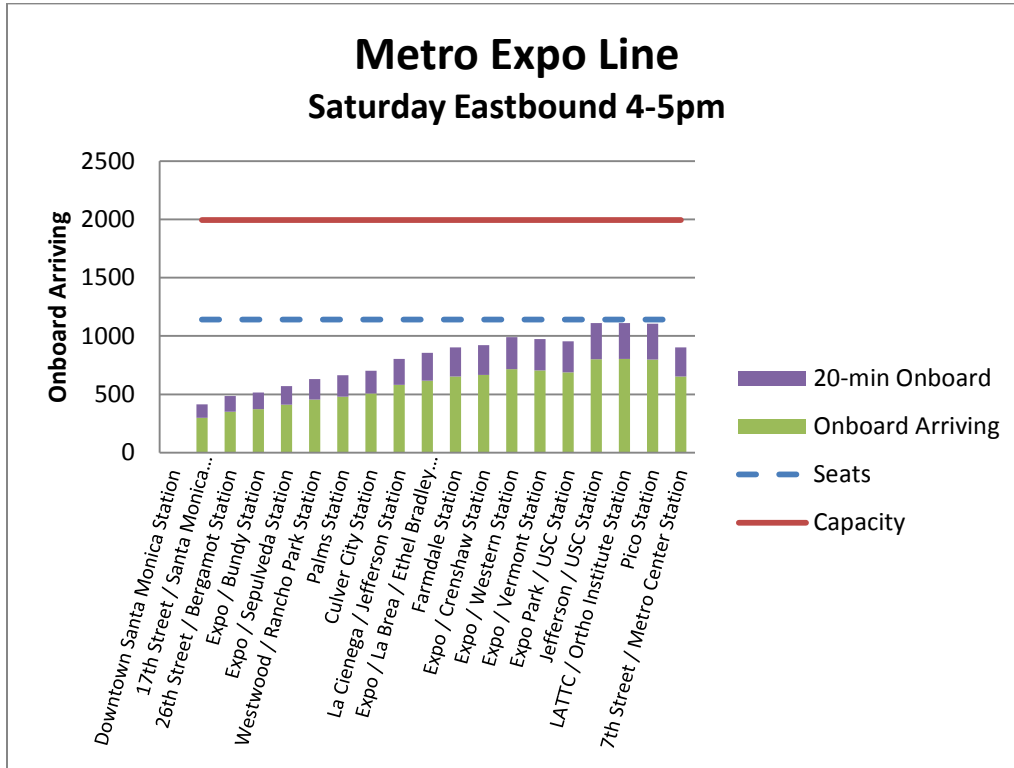
METRO EXPO LINE
Weekday Peak Hours



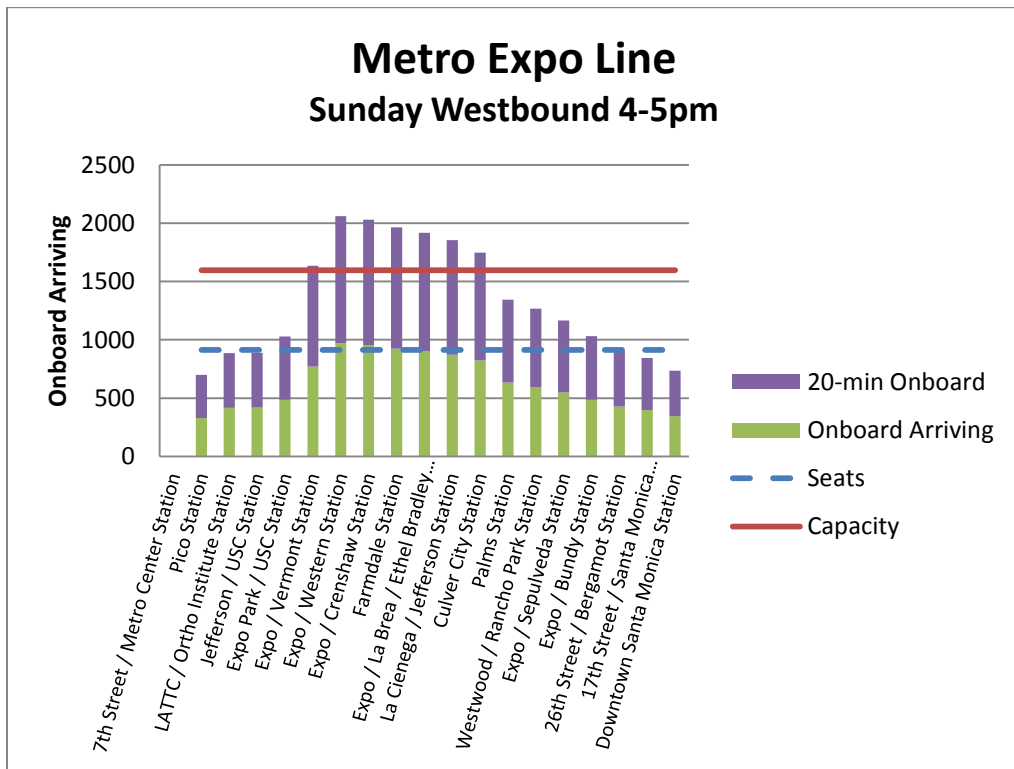
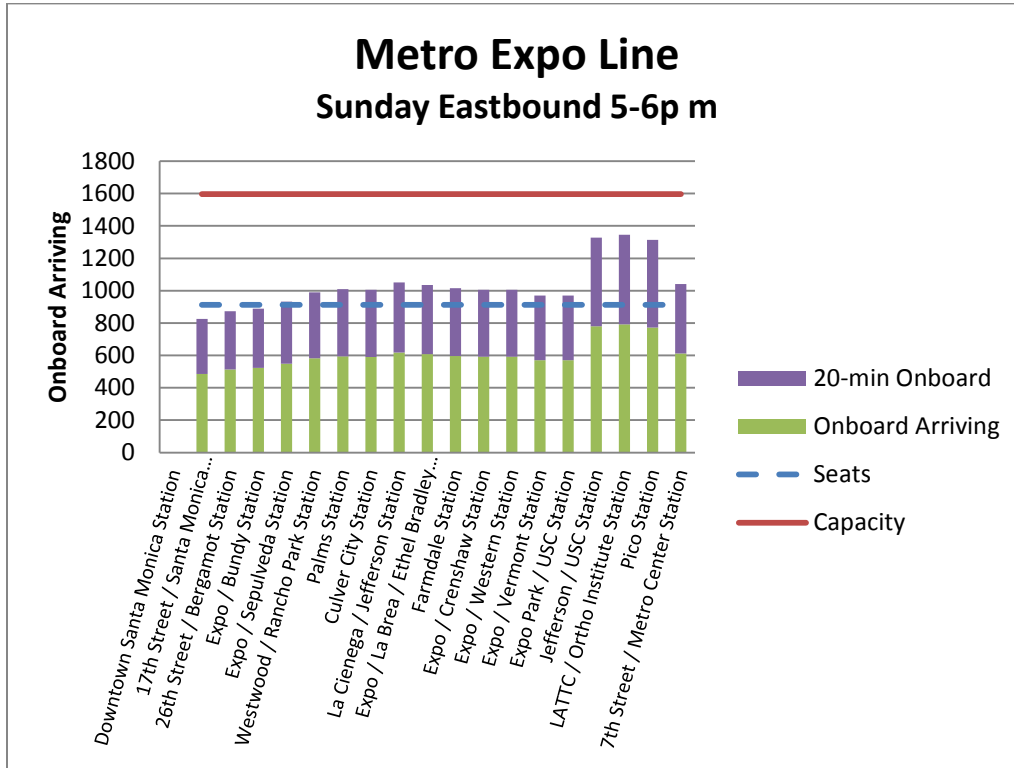
METRO EXPO LINE
Weekday Off Peak Hours



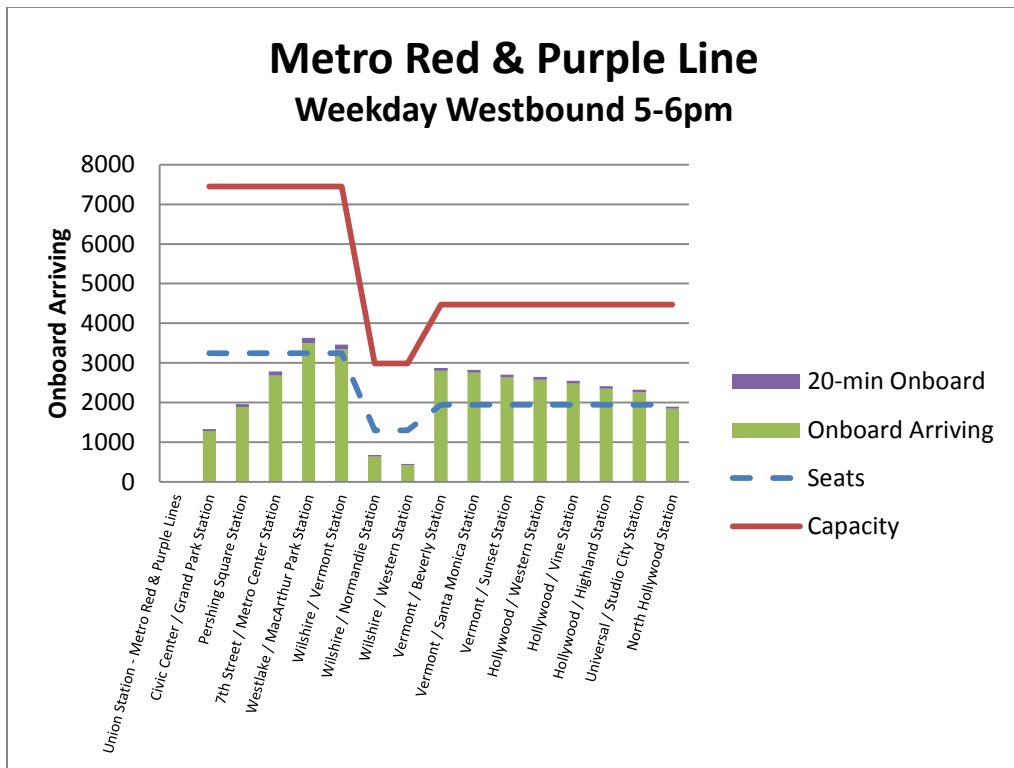
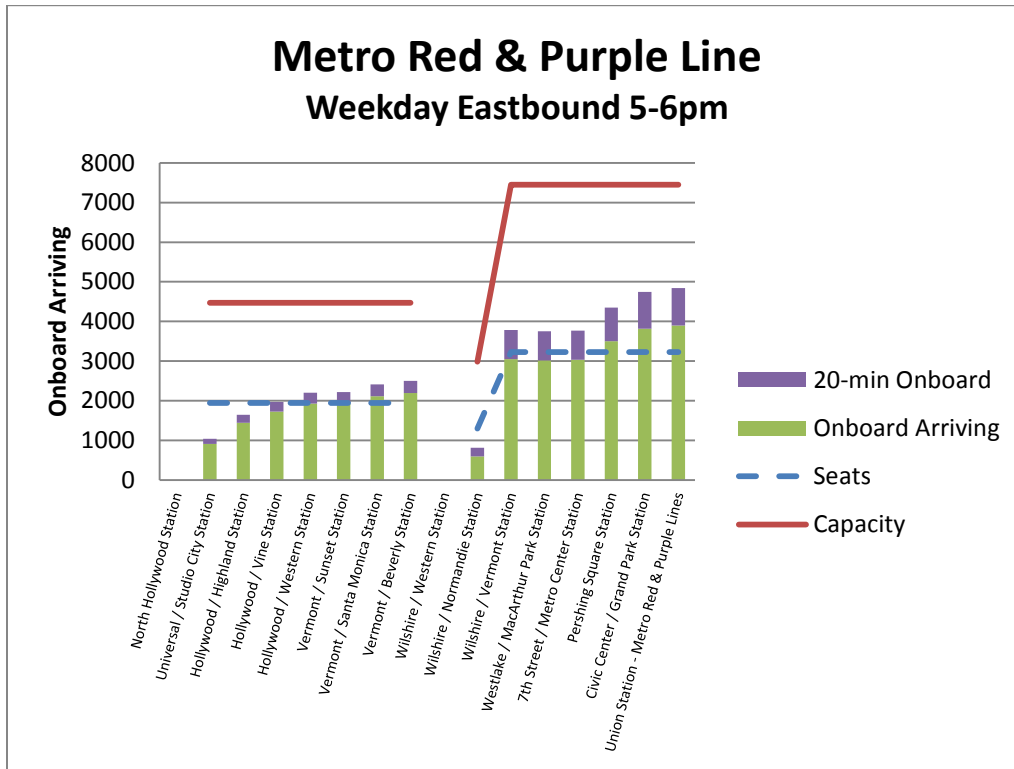
METRO EXPO LINE
Saturdays



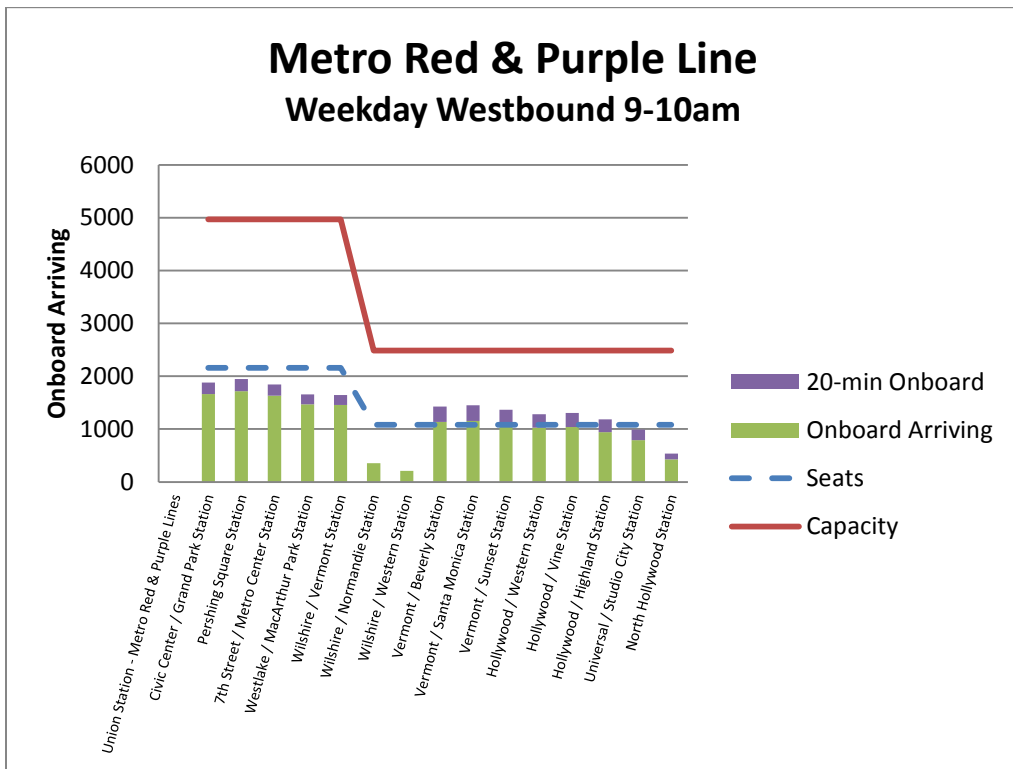
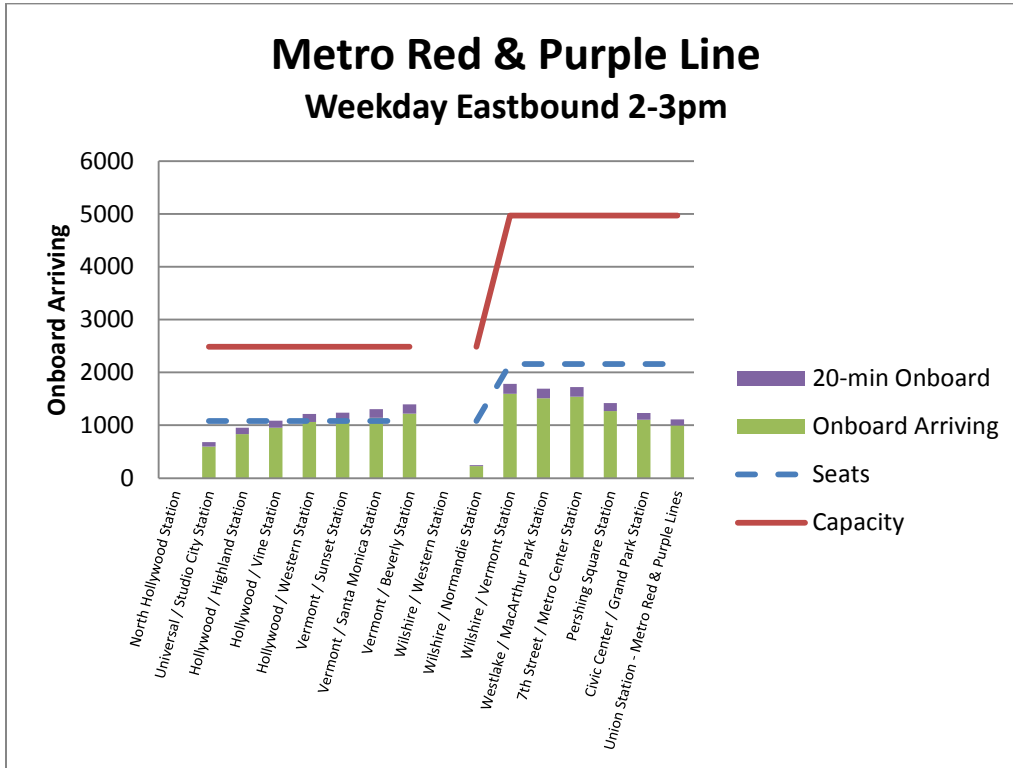
METRO EXPO LINE
Sundays



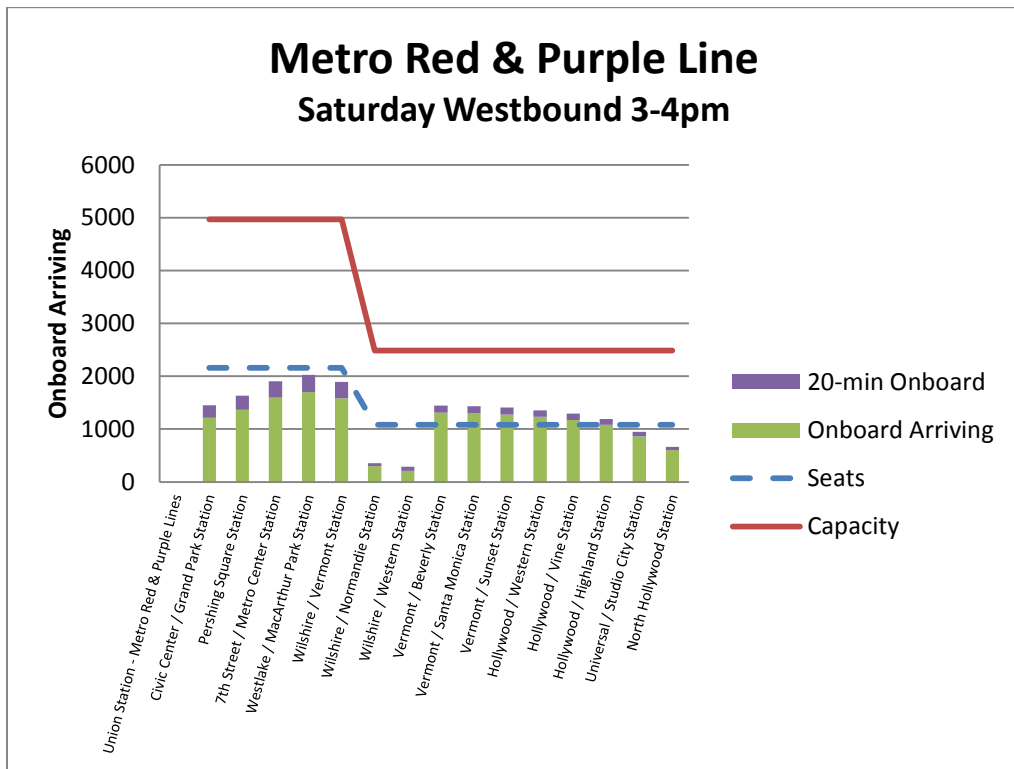
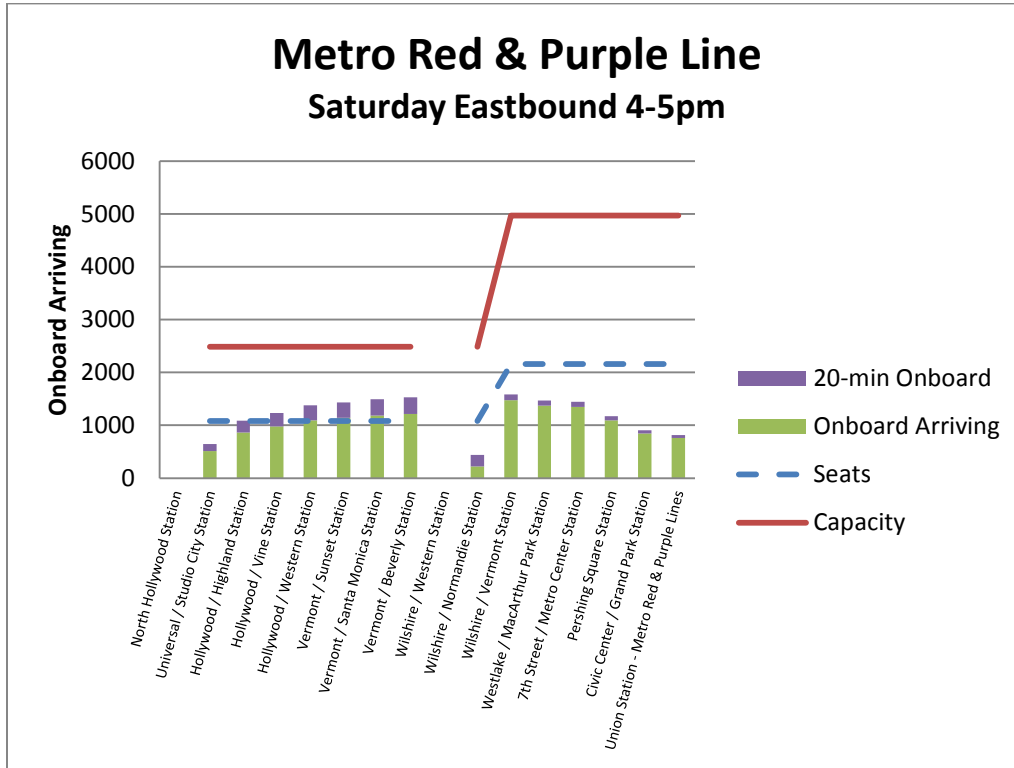
METRO RED/PURPLE LINES
Weekday Peak Hours



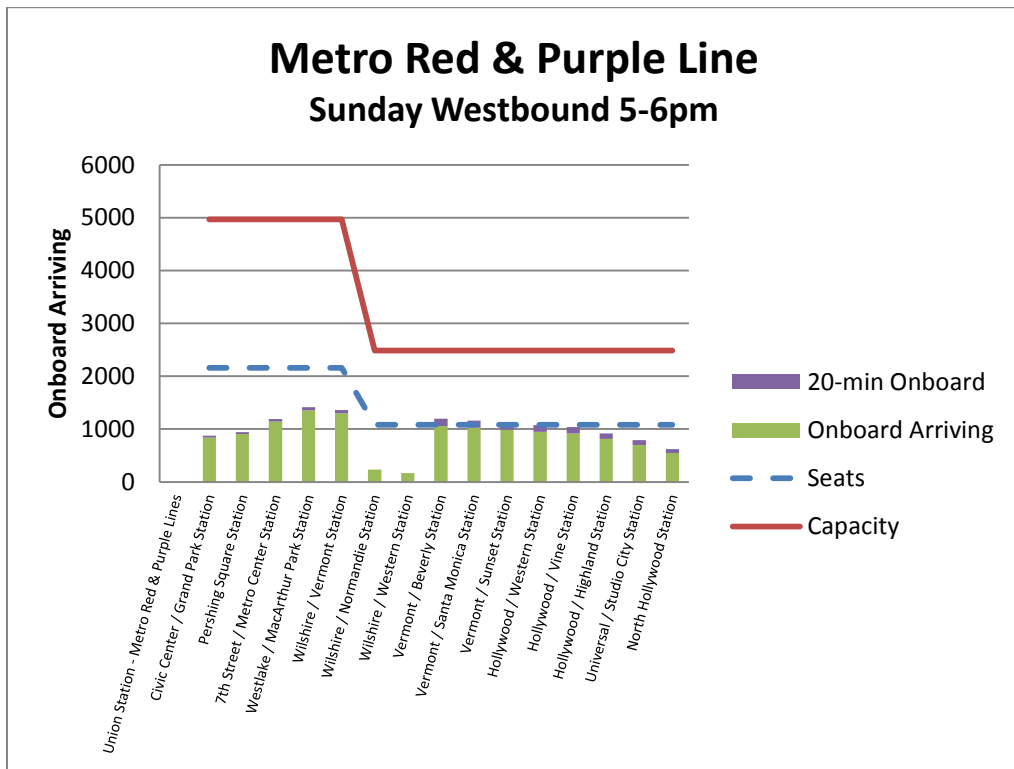
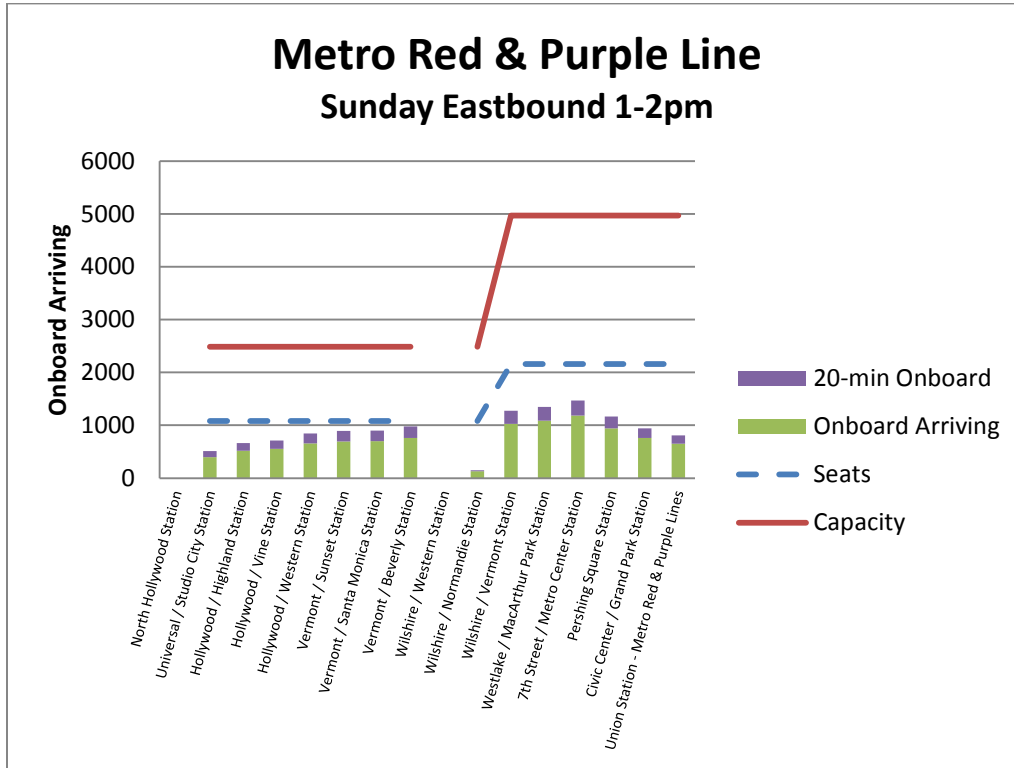
METRO RED/PURPLE LINES
Weekday Off Peak Hours



METRO RED/PURPLE LINES
Saturdays



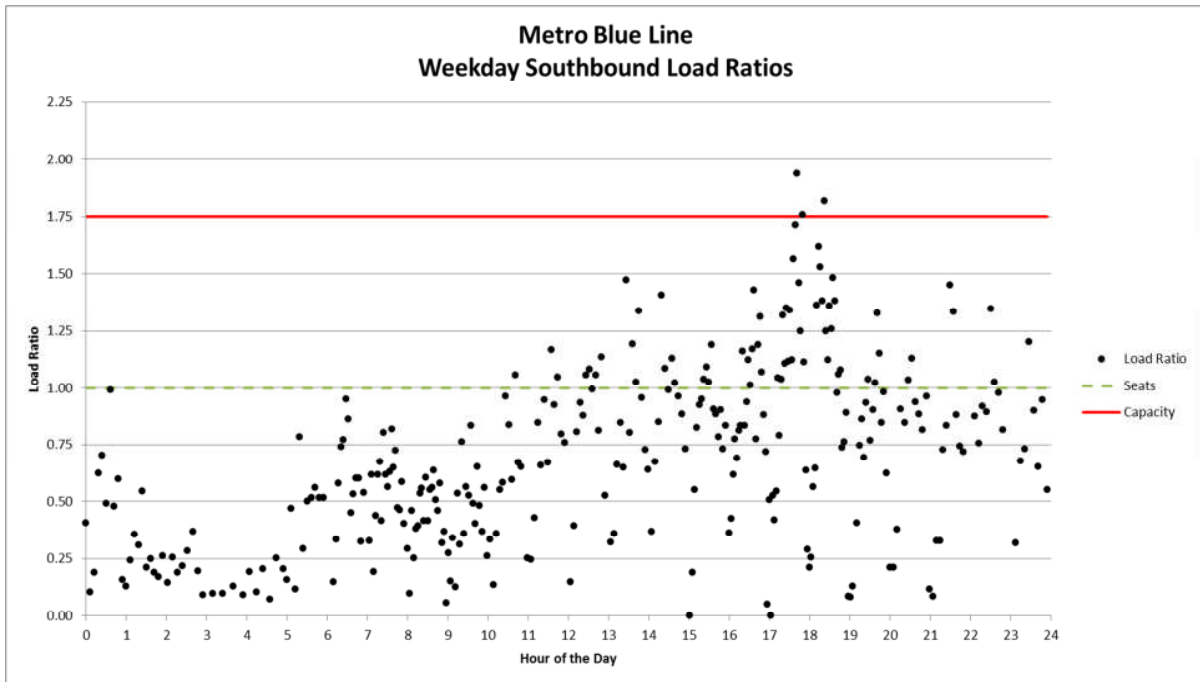
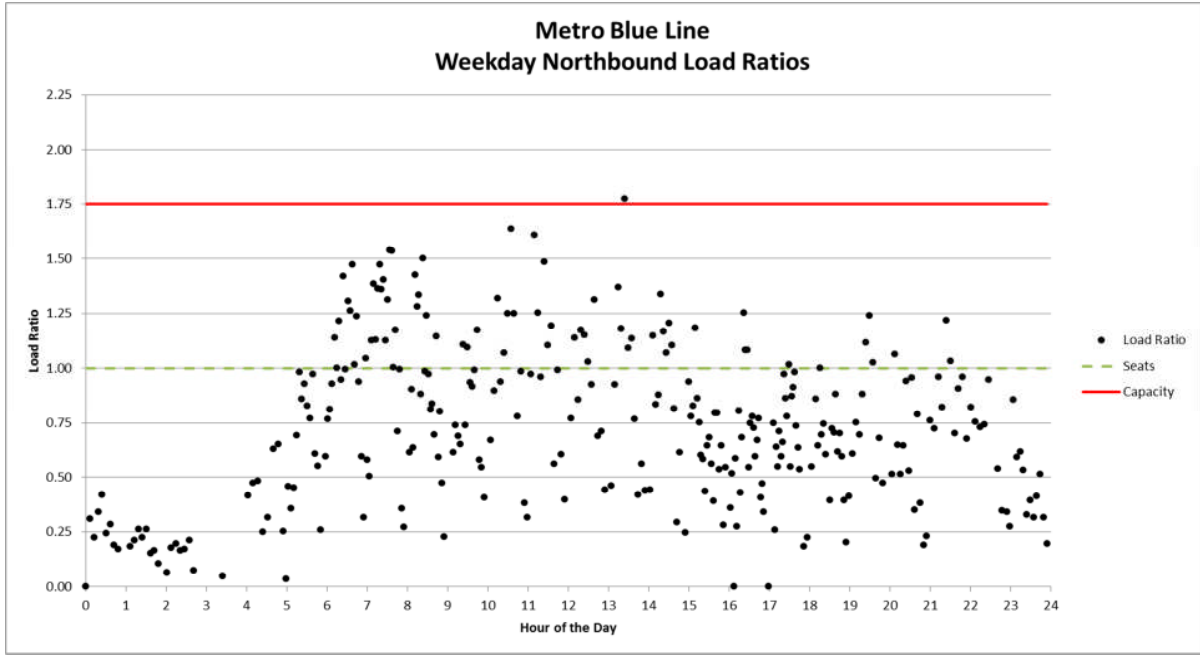
METRO RED/PURPLE LINES
Sundays



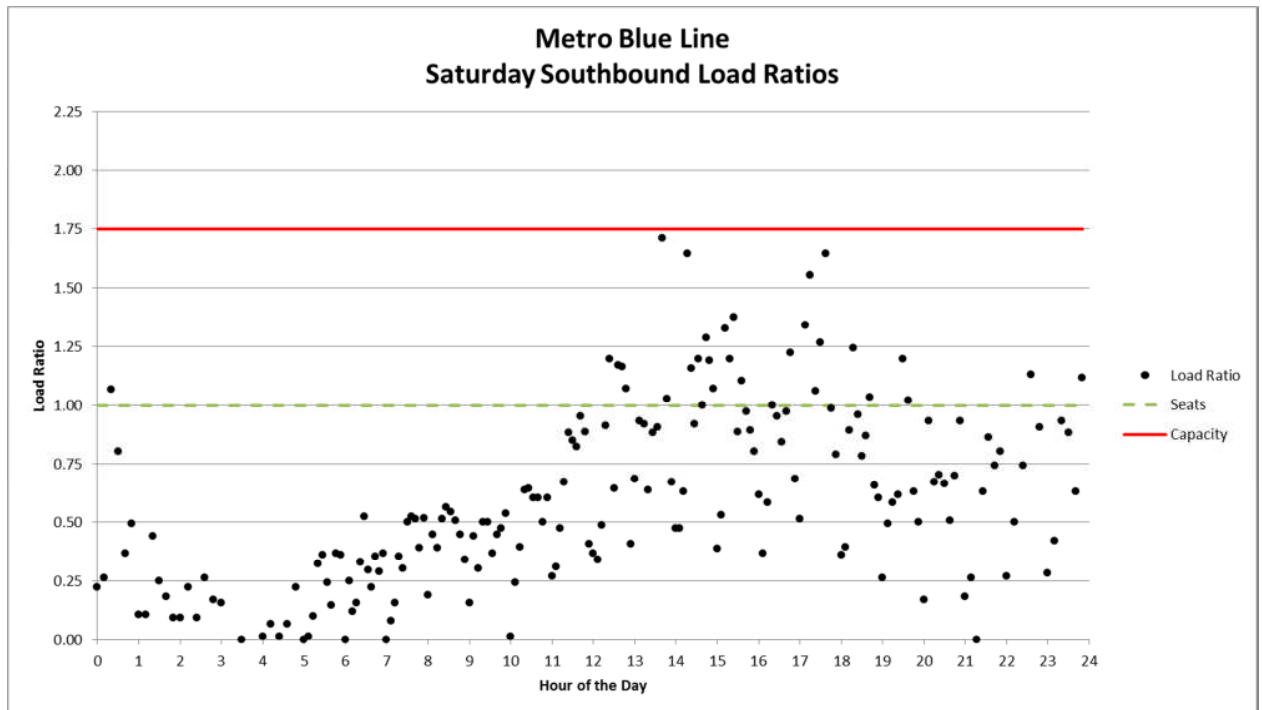
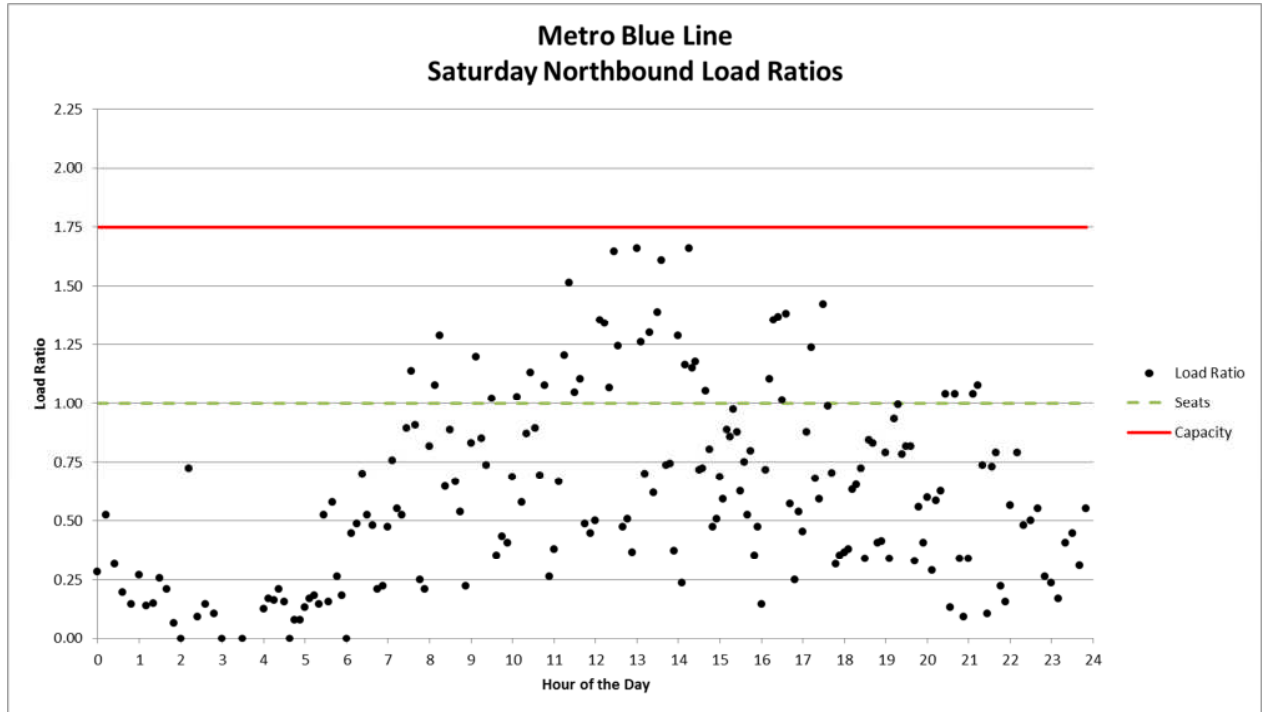
REVISED - ATTACHMENT C

Train By Train Loading in Relation to Train Capacity

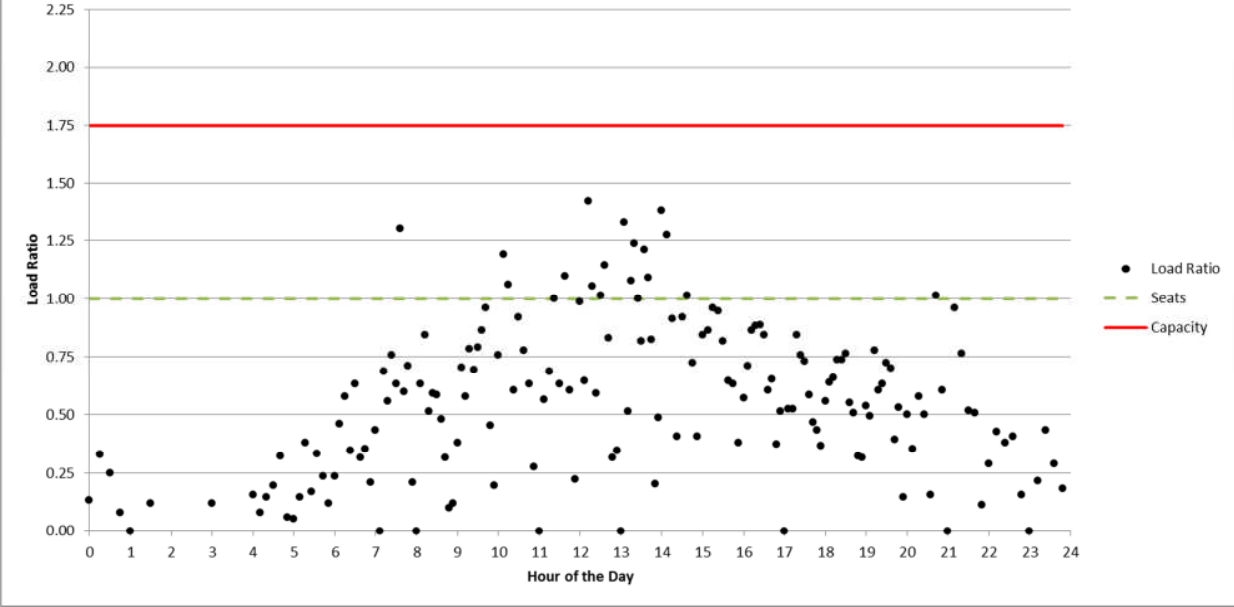
**METRO BLUE LINE
WEEKDAY LOAD RATIOS**



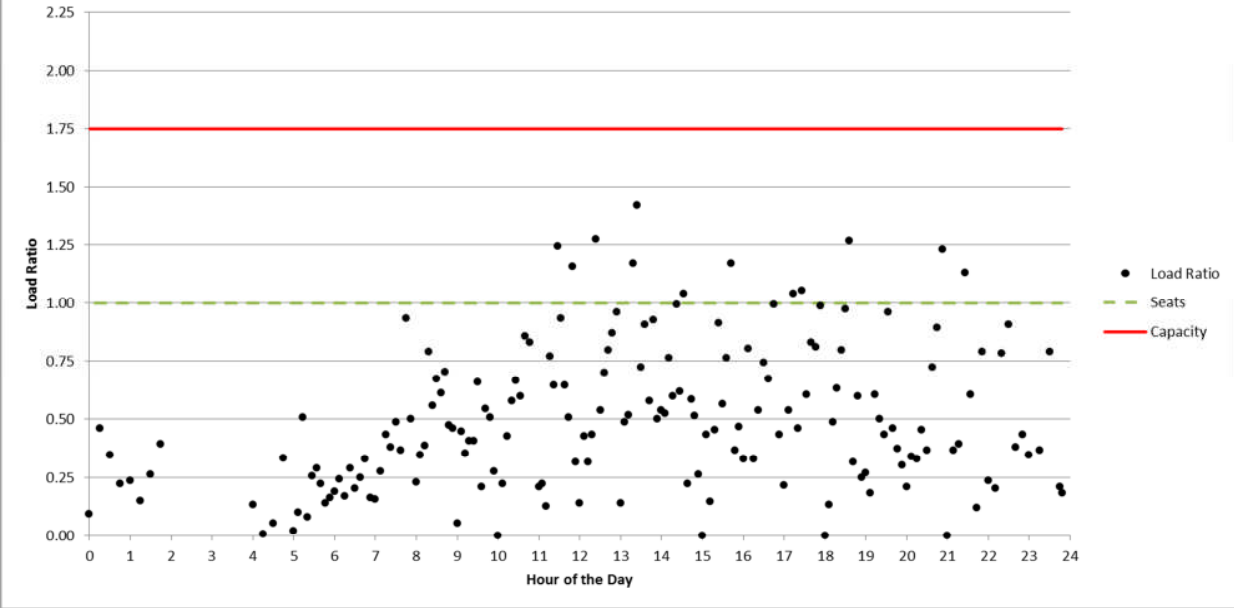
METRO BLUE LINE
WEEKEND LOAD RATIOS



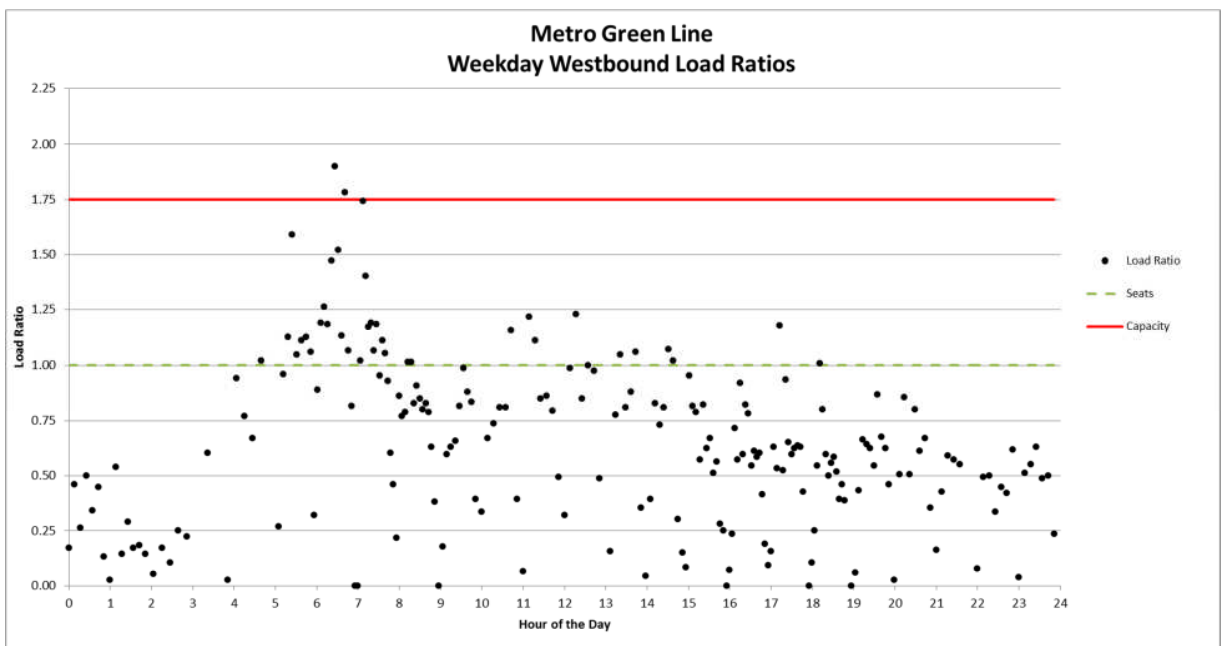
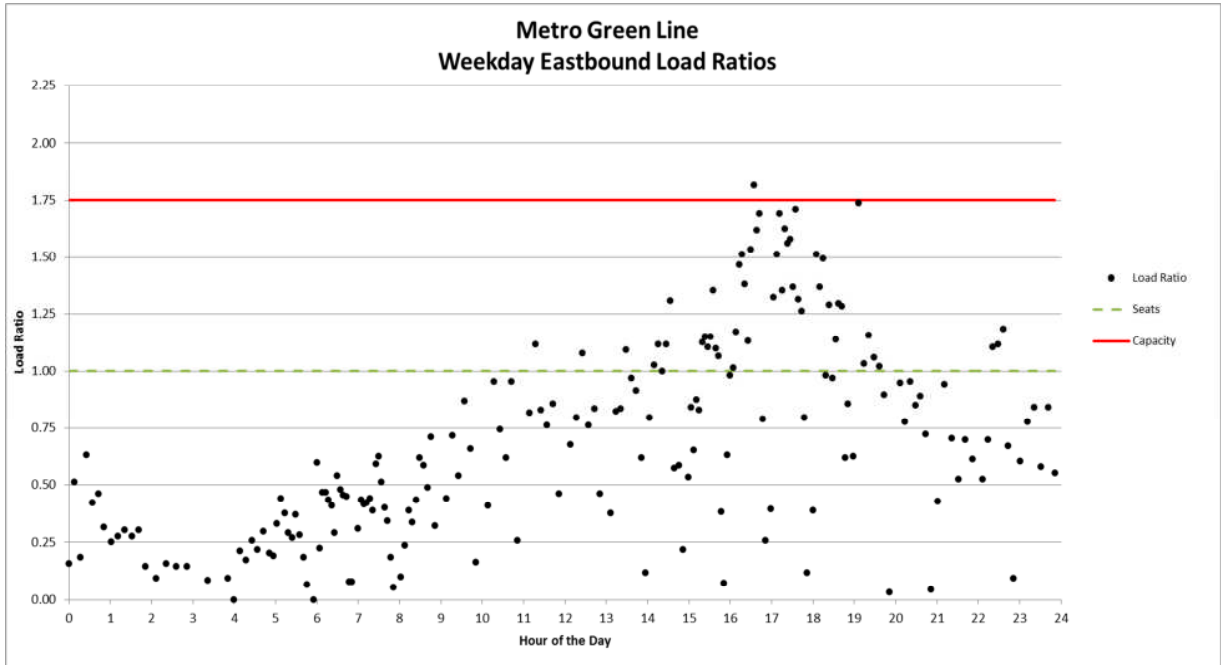
**Metro Blue Line
Sunday Northbound Load Ratios**



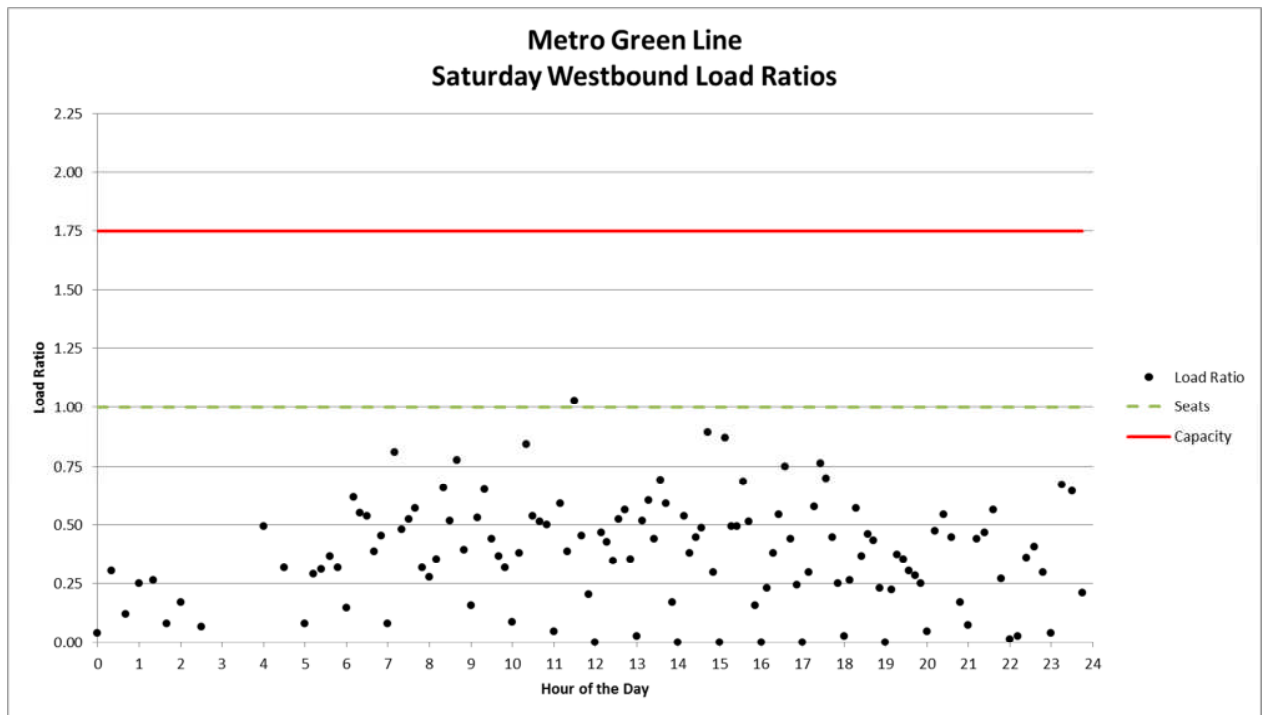
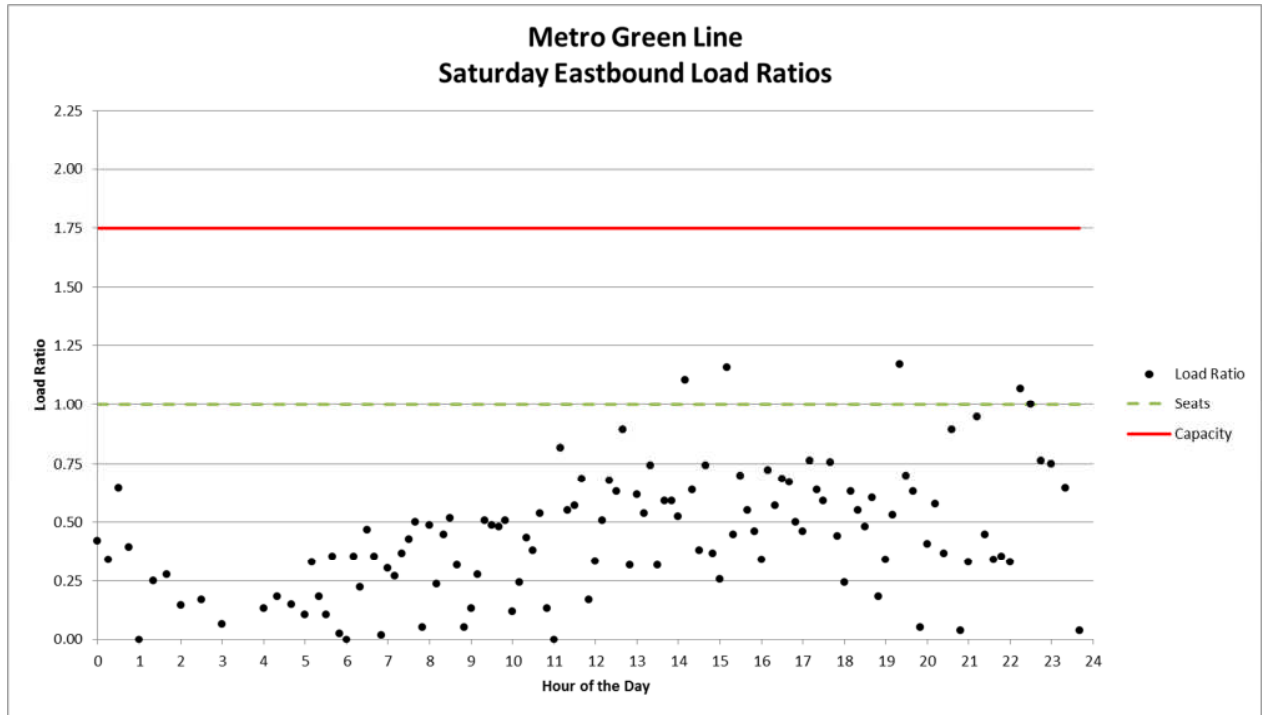
**Metro Blue Line
Sunday Southbound Load Ratios**



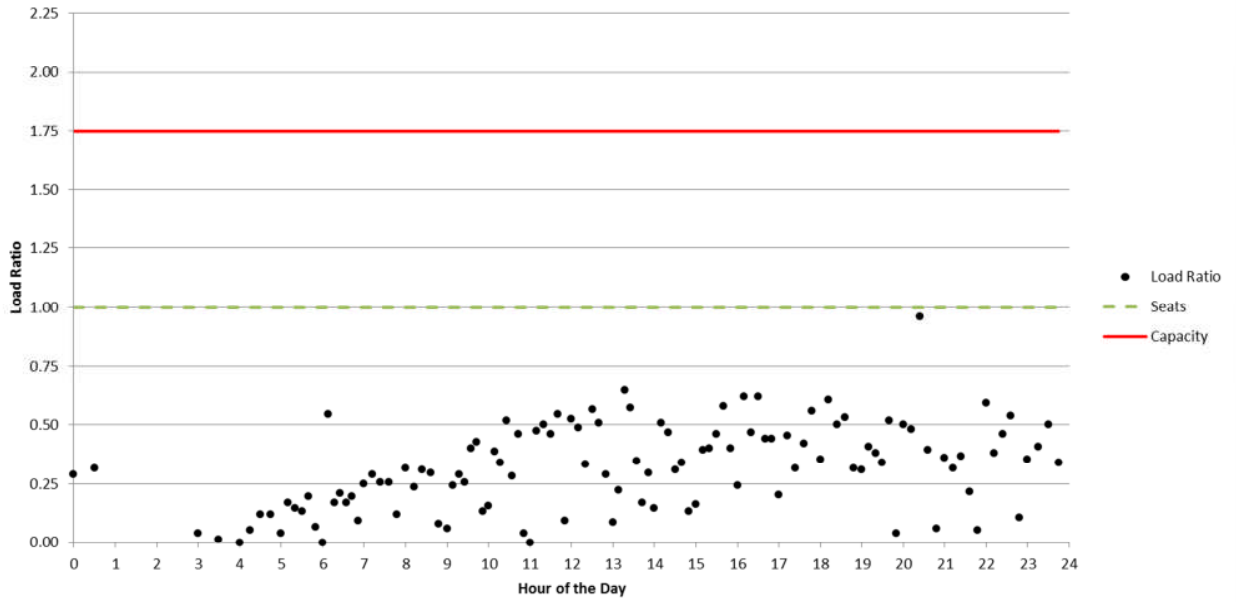
METRO GREEN LINE WEEKDAY LOAD RATIOS



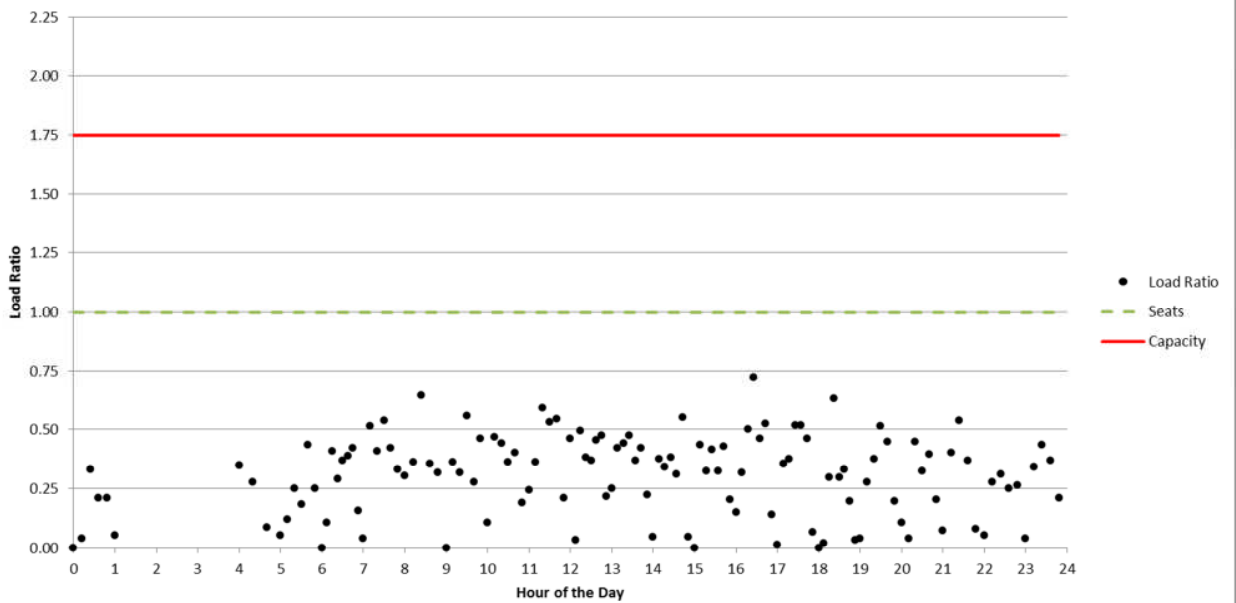
METRO GREEN LINE
WEEKEND LOAD RATIOS



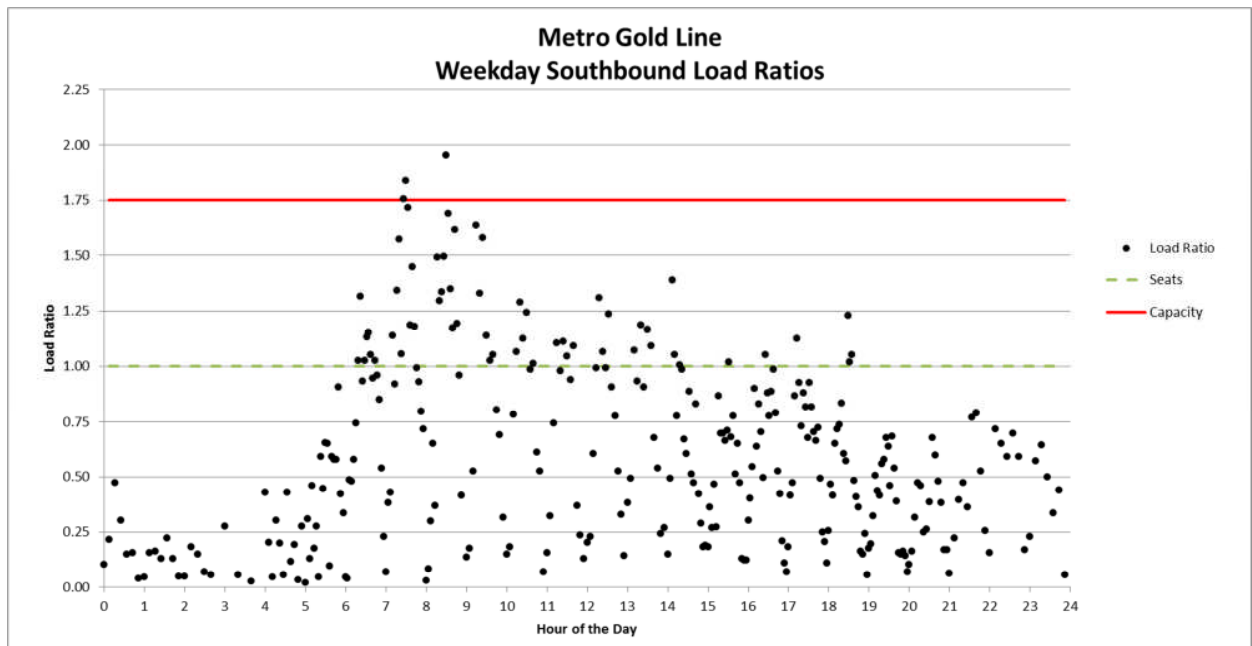
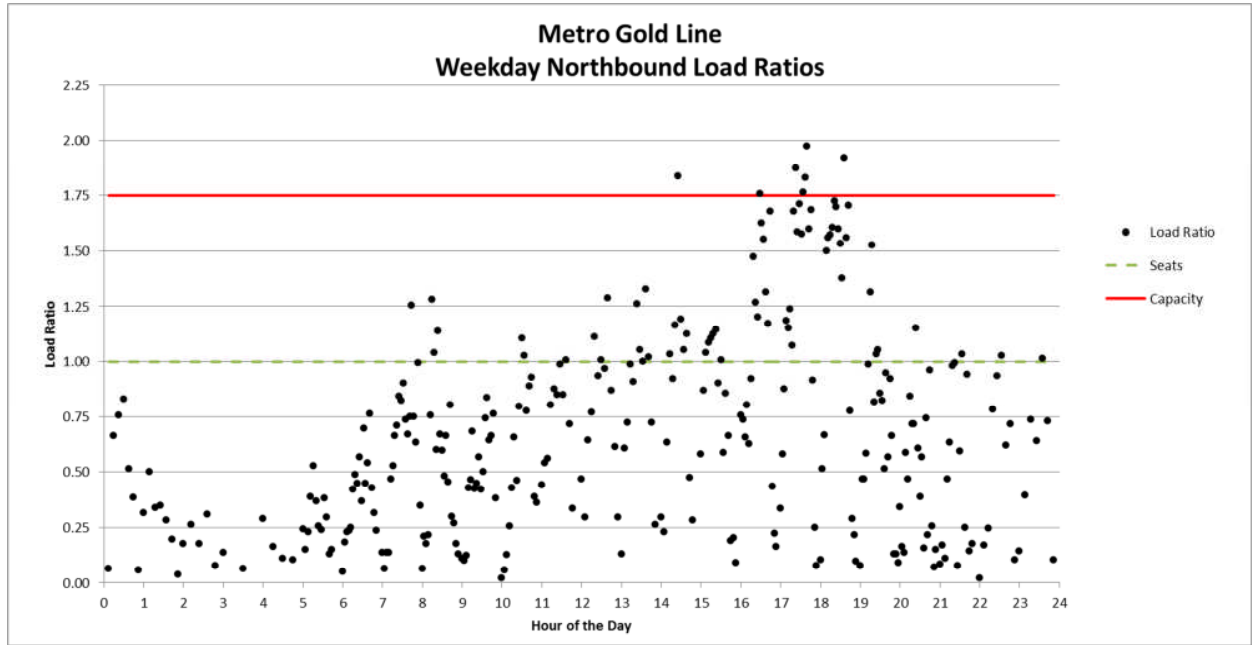
Metro Green Line Sunday Eastbound Load Ratios



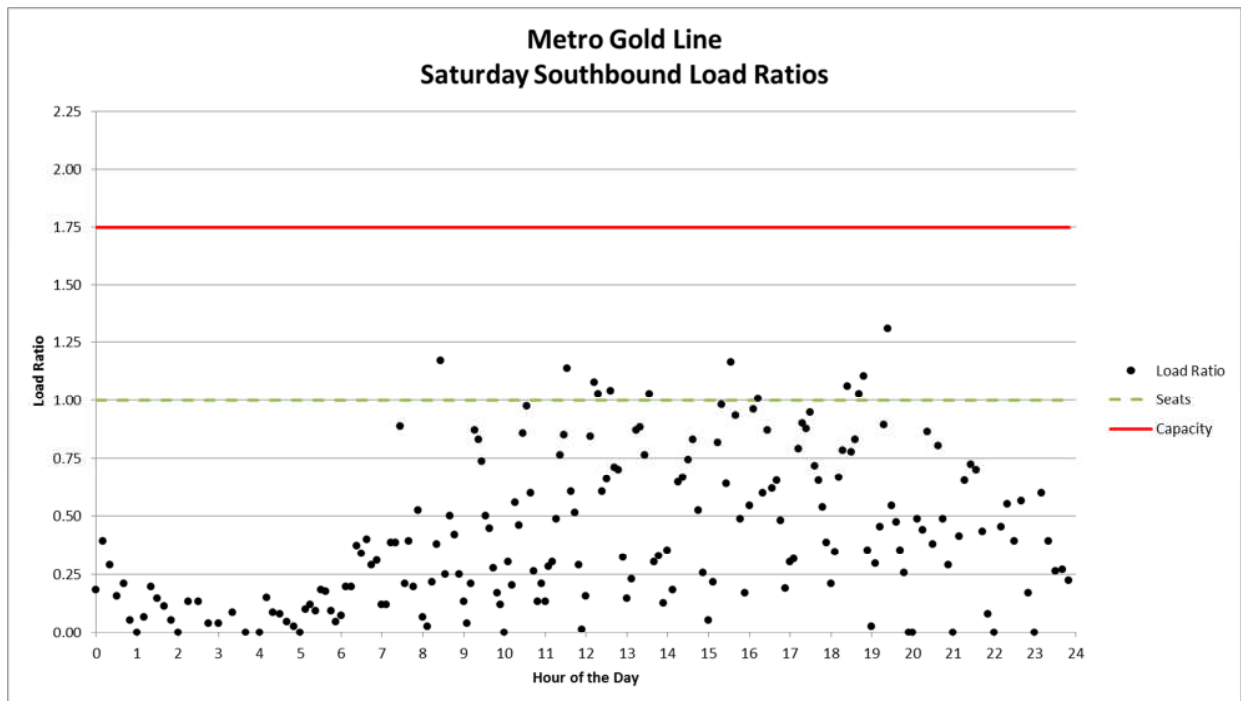
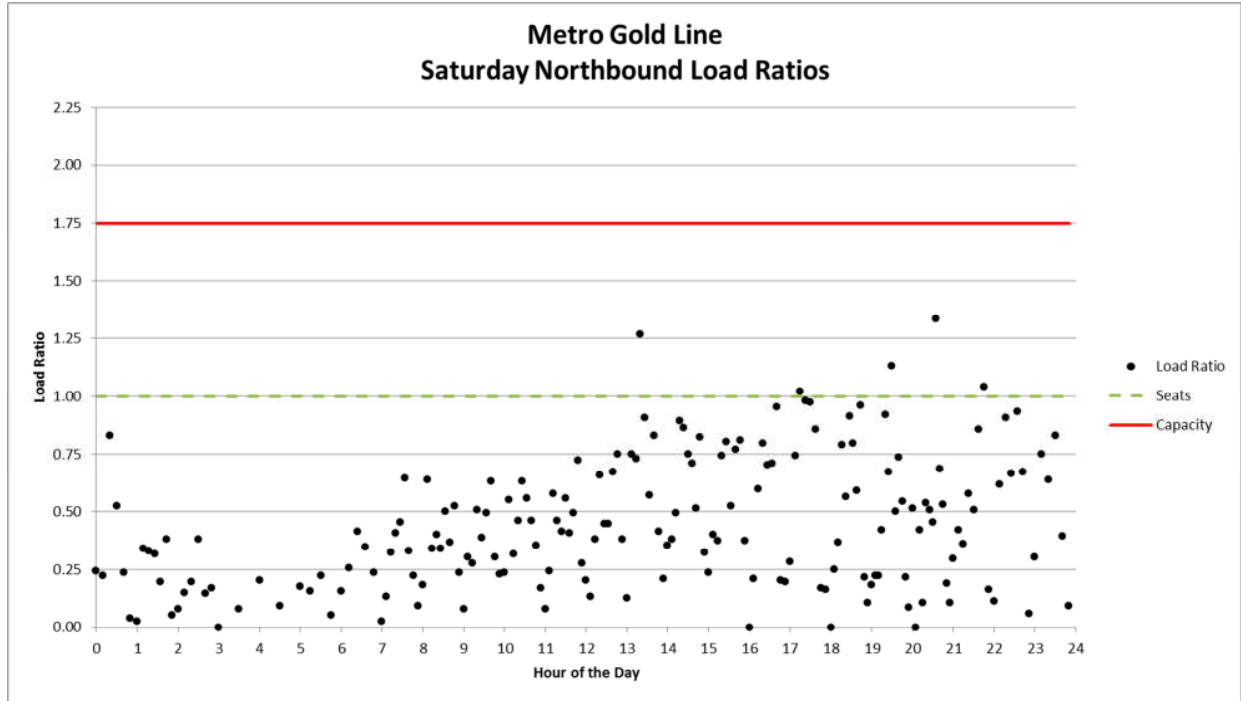
Metro Green Line Sunday Westbound Load Ratios



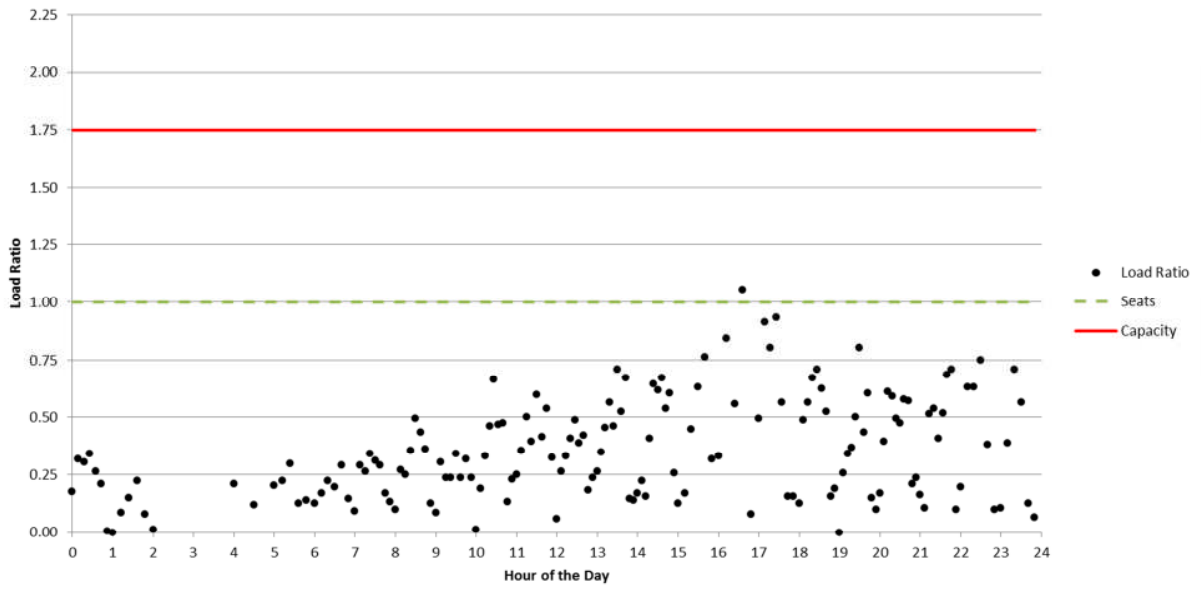
METRO GOLD LINE WEEKDAY LOAD RATIOS



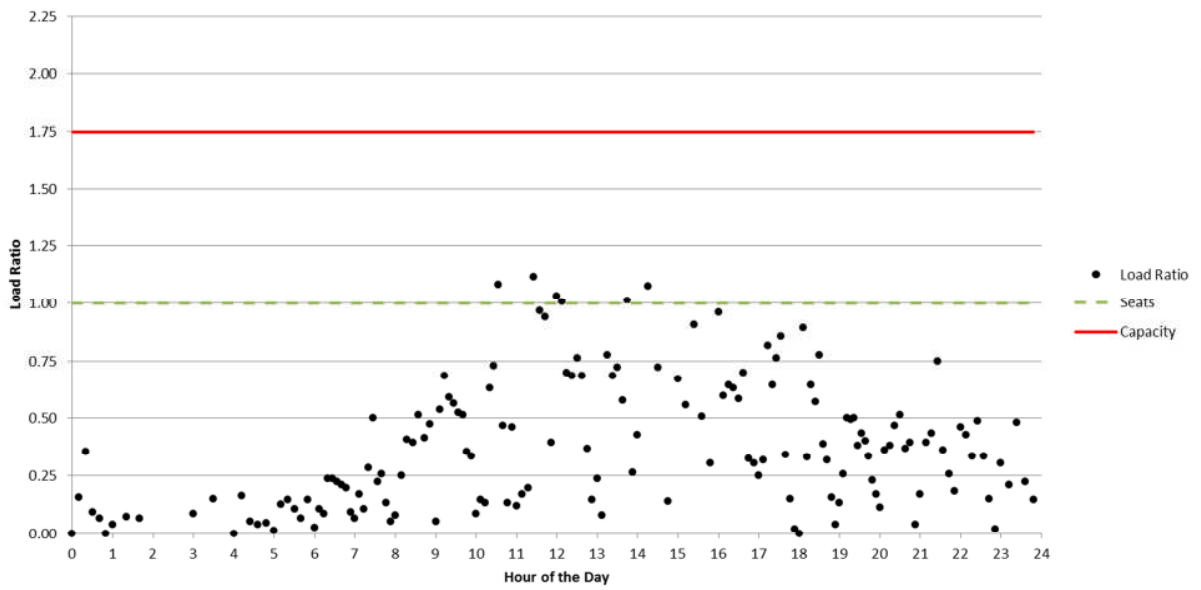
METRO GOLD LINE
WEEKEND LOAD RATIOS



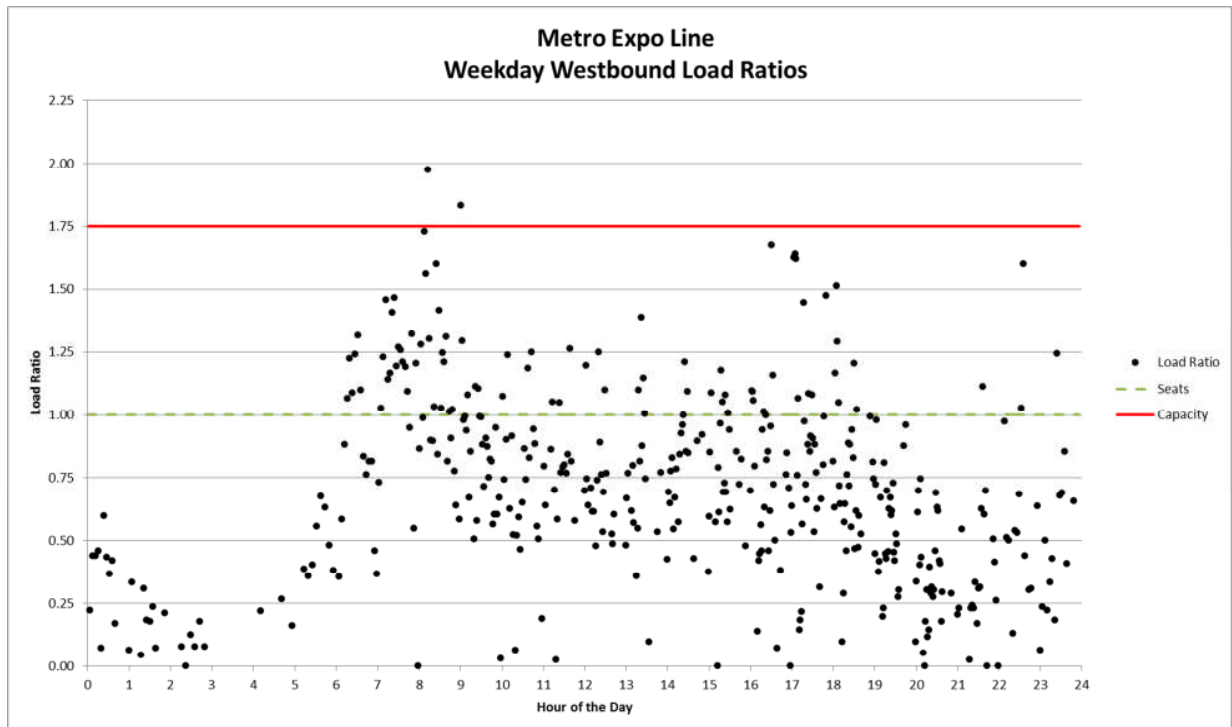
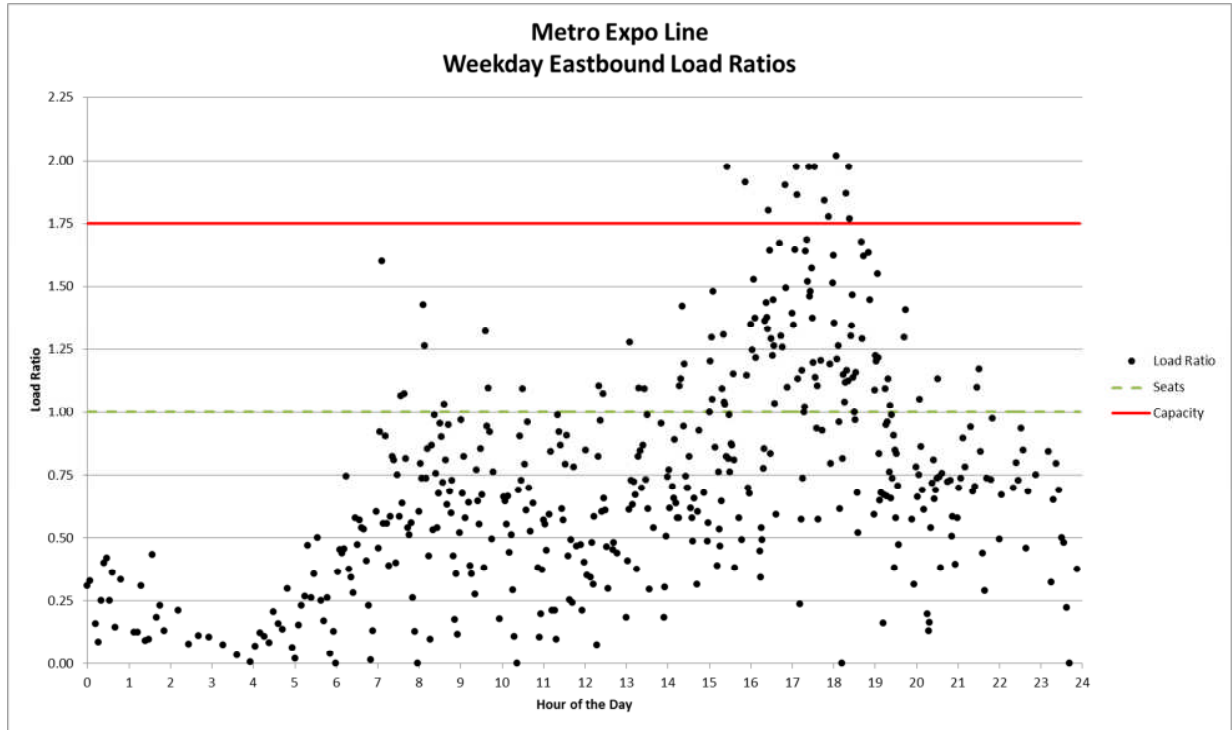
Metro Gold Line Sunday Northbound Load Ratios



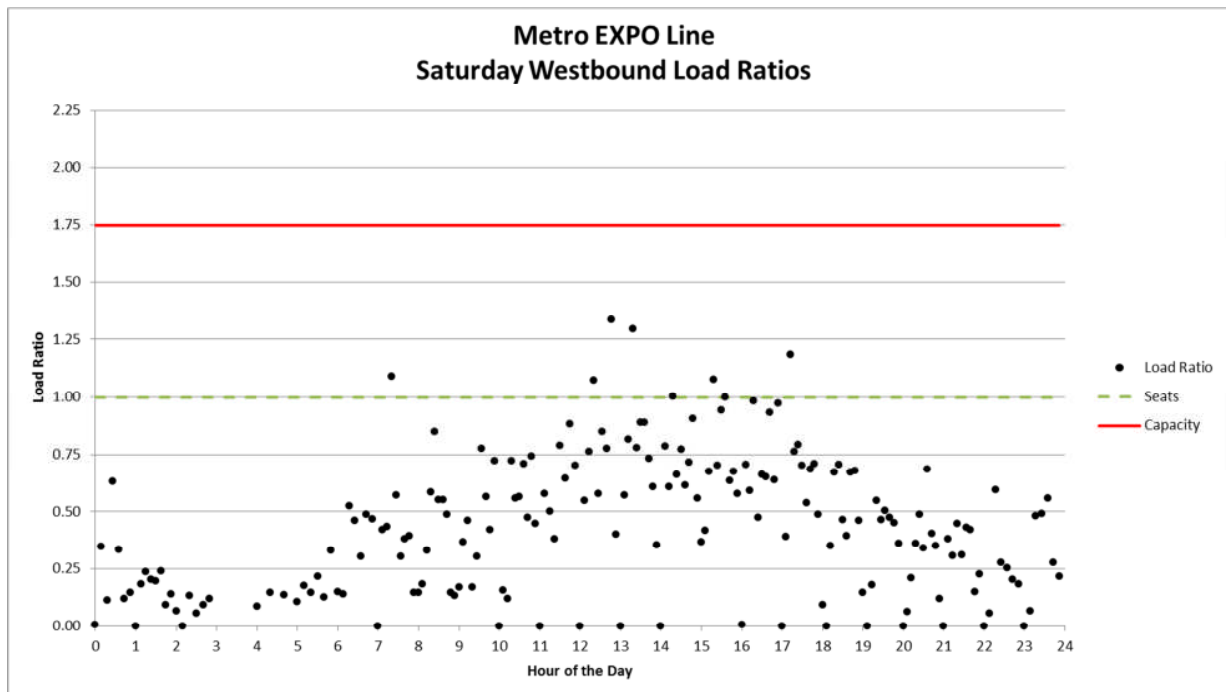
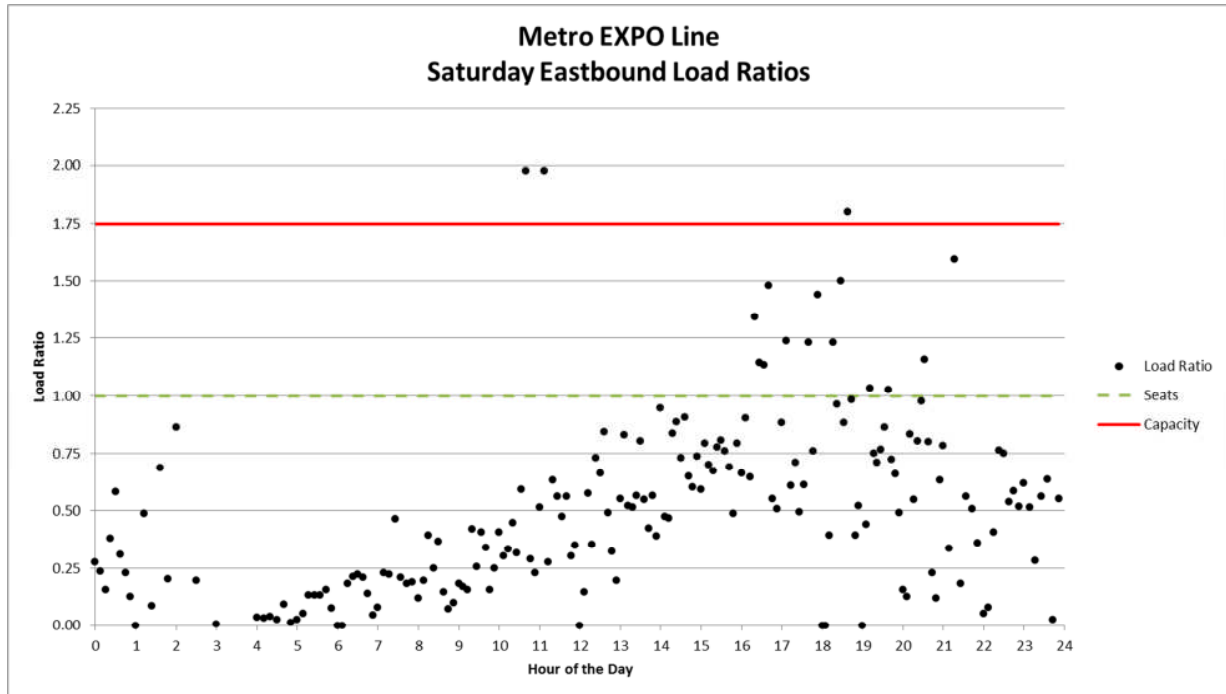
Metro Gold Line Sunday Southbound Load Ratios



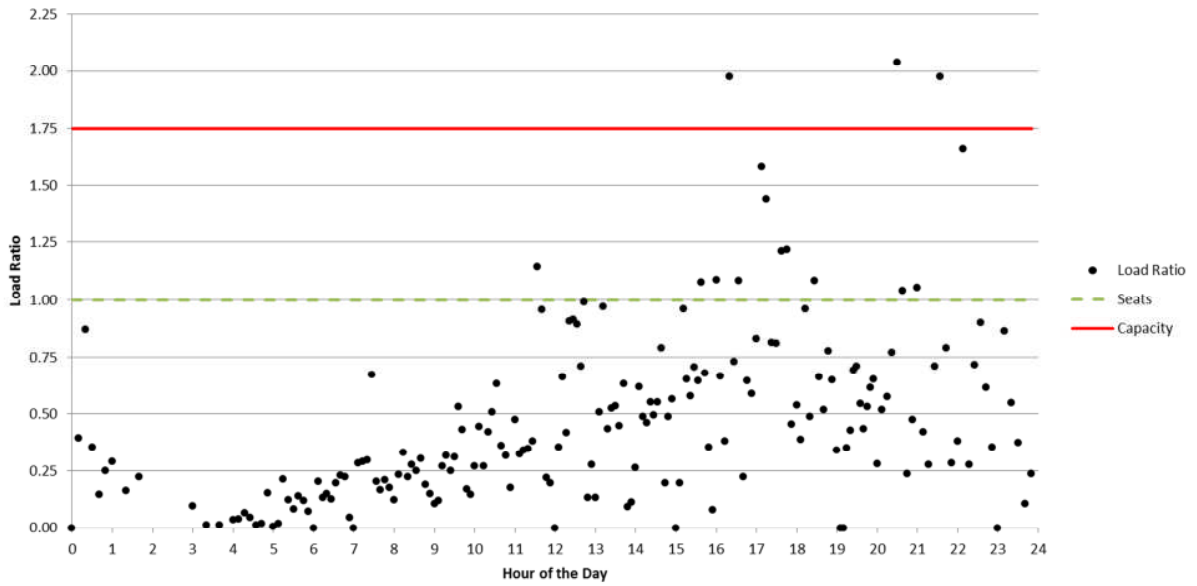
METRO EXPO LINE WEEKDAY LOAD RATIOS



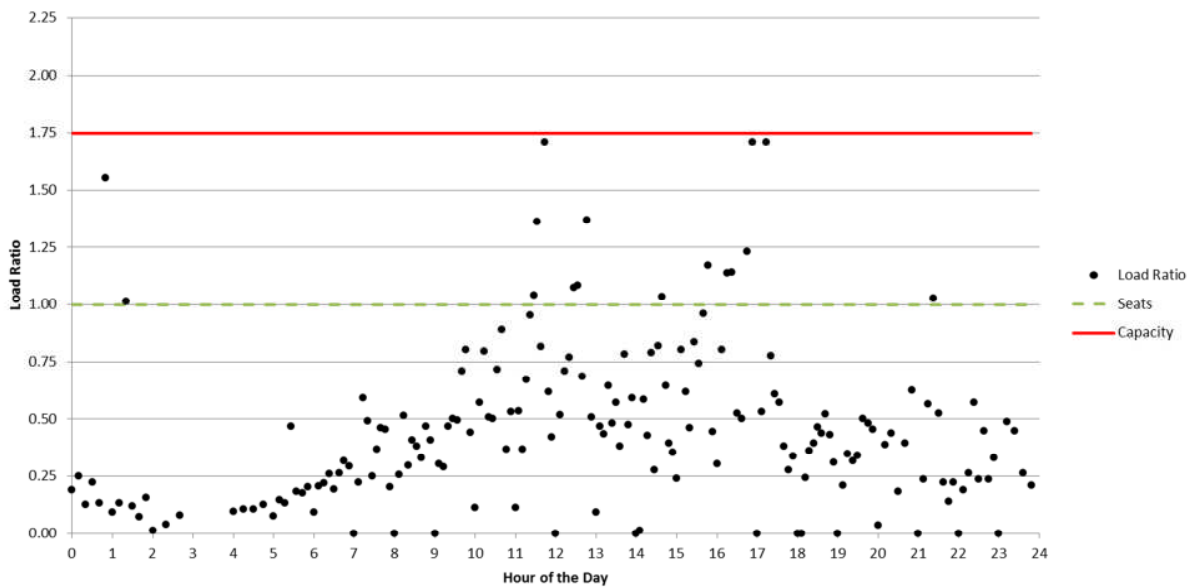
METRO EXPO LINE
WEEKEND LOAD RATIOS



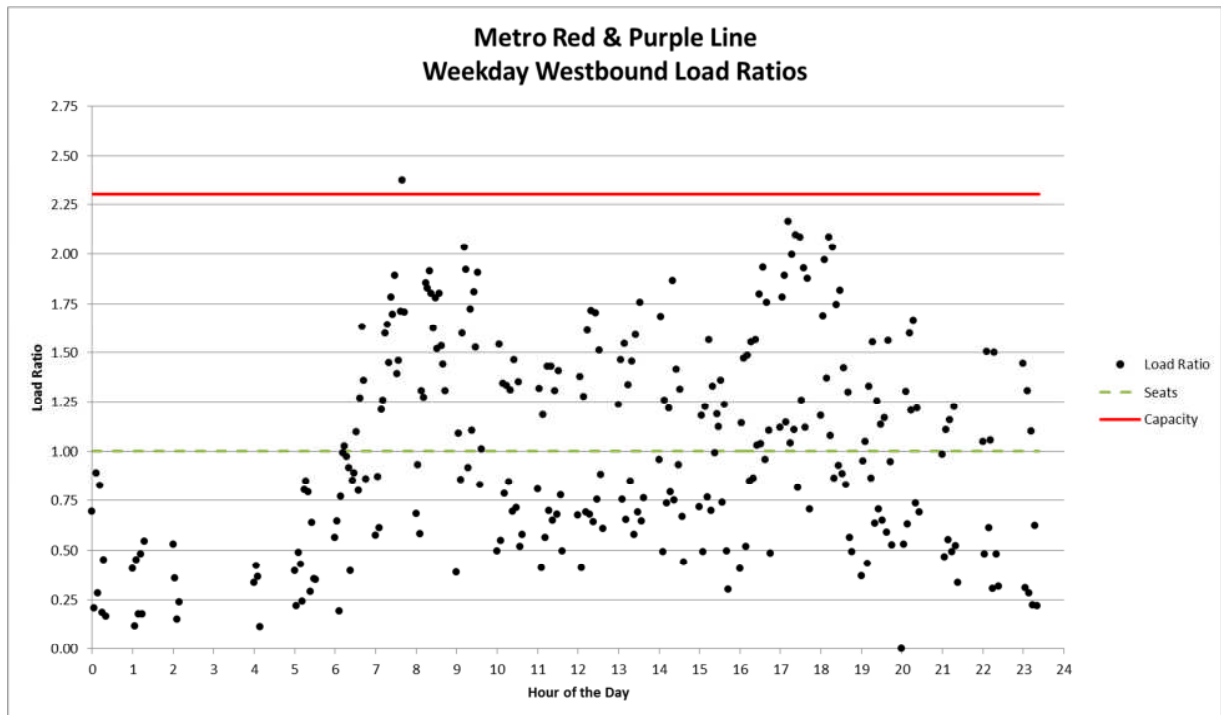
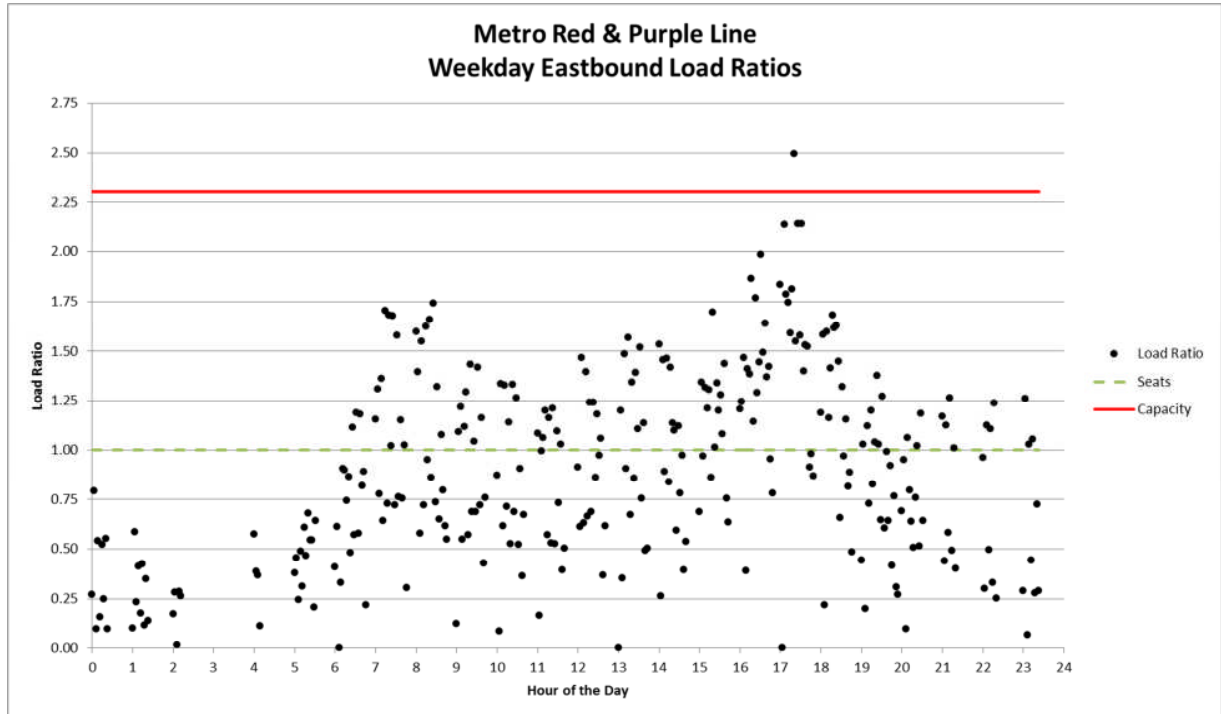
Metro EXPO Line Sunday Eastbound Load Ratios



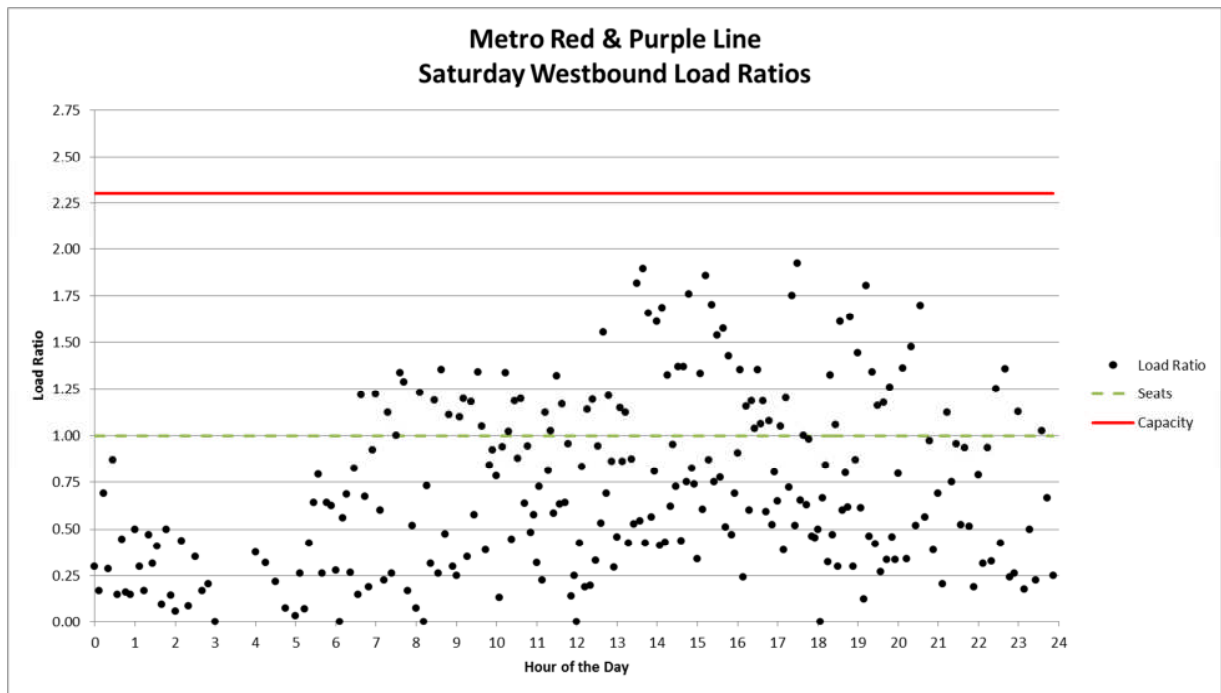
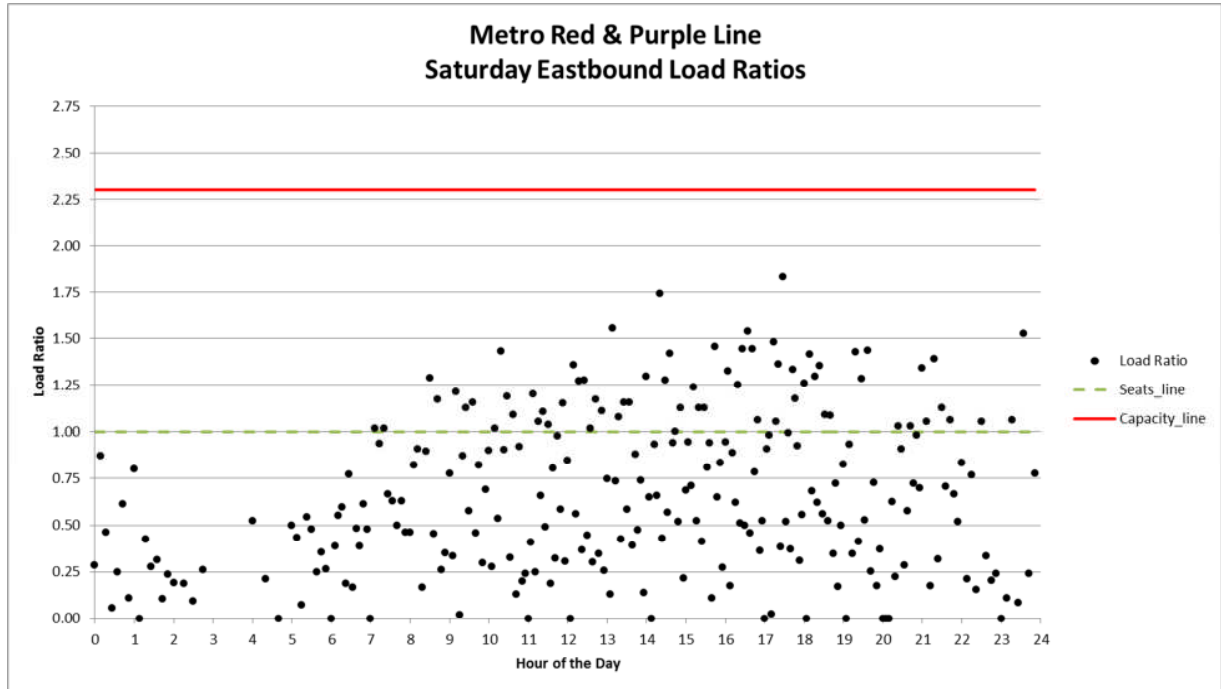
Metro EXPO Line Sunday Westbound Load Ratios



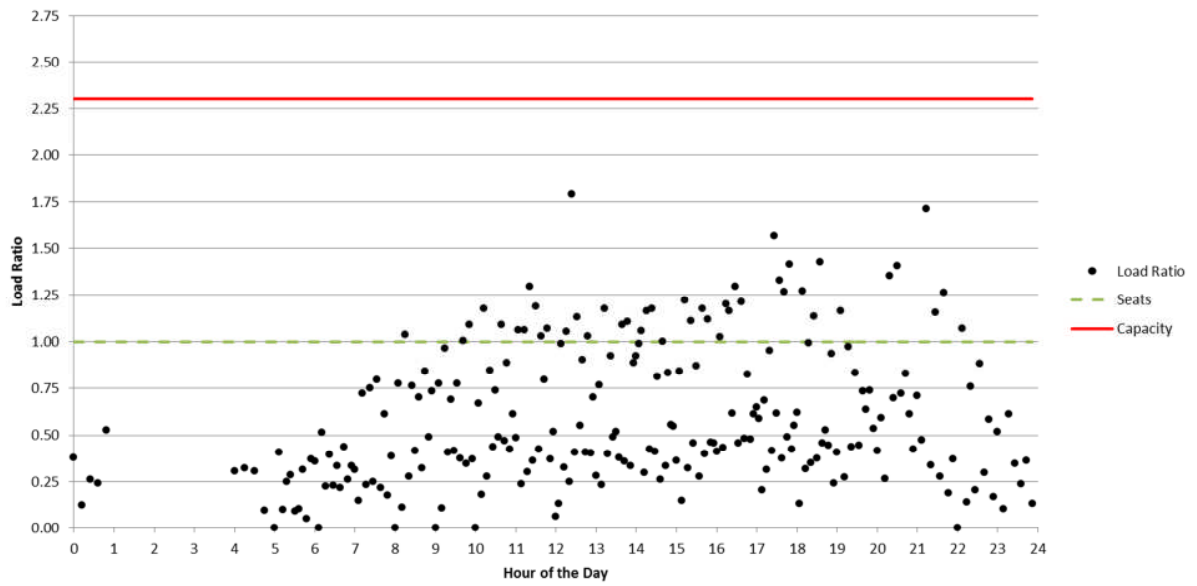
METRO RED/PURPLE LINE WEEKDAY LOAD RATIOS



METRO RED/PURPLE LINE
WEEKEND LOAD RATIOS



Metro Red & Purple Line Sunday Westbound Load Ratios



Metro Red & Purple Line Sunday Eastbound Load Ratios

